Science Education

EVALUATION OF STUDENTS' SCIENTIFIC DRAWINGS *

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Teachers of science, as well as those whom they teach, need a clearly defined standard for evaluating the quality of drawings that are made by the student as a part of the learning process. The drawing is quite generally used in the laboratory notebook and such values would be especially helpful if there applied. This discussion is presented as a preparation and basis for further work on construction of objective scales for grading the quality of that type of drawing which is executed by the learner as an aid to learning in science.

Previous studies of the drawing as an aid to learning in science have given data on four principal problems. One such problem was the relative value of drawing with ink or pencil. A second was the comparative effectiveness of the diagram method and the verbal method of reporting laboratory exercises. Another was the relative value of a labeling of the prepared drawing and an execution of the entire drawing by the student. A fourth problem was concerned with the relative merits of the representative drawing and the analytical drawing. The studies made thus far have been in terms of method of execution of the drawing and kinds of drawing executed. The values upon which comparisons have been made have been general ones, such as, memory and thinking. There is need for progression from these studies along lines to be here indicated.

Some typical drawings made by science students are shown herewith. They have been selected in order to illustrate features relative to which drawings are and may be judged. Such features or values may therefore form a basis for construction of performance or rating scales. Examination of these drawings reveals two different kinds or sets of values.

The first kind of value relative to which drawings may be judged is of a *structural* nature. Very frequently laboratory drawings are rated on structural features. Students are often only aware of structural characteristics and they thus attempt to meet only structural standards. This basis may be of least value educationally. Structural values were the ones mentioned by a selected group of teachers to whom these drawings were submitted with request for reasons for judgment as of good or poor quality.

The odd-numbered figures were said to be good; the even-numbered ones poor in quality. The odd-numbered drawings were rated as of good quality for reasons given by teachers and tabulated as follows:

1. Lines:
   a. Distinct.
   b. Continuous.
   c. With ruler.
   d. Different intensities.
2. Shading:
   a. Not too much.
   b. Differential.
3. Labeling:
   a. Full and complete.
   b. Not crowded.
   c. Printed.
   d. Clear.
4. Size:
   a. Sufficiently large.
   b. When more than one, not crowded.
5. Cleanliness.

The even-numbered drawings were rated as of poor quality when negative and opposite characteristics of the tabulation appeared.

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It will be noted that the basis for the foregoing estimation of quality is structural.

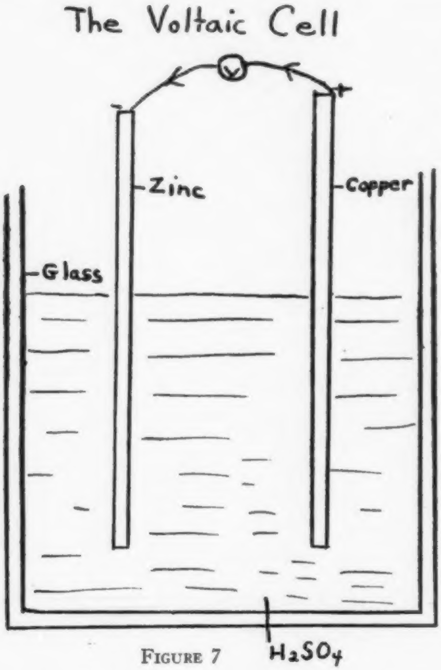

FIGURE 7

There is also a *conceptual* basis for judgment of drawings. Teachers do not use

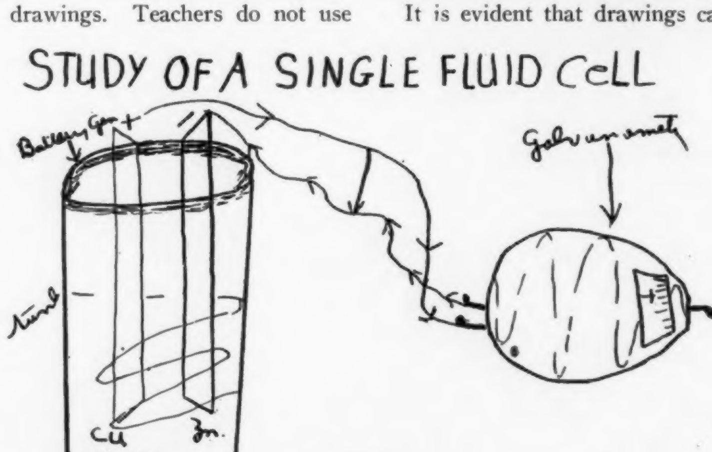

FIGURE 8

this evaluation so frequently. Application of this value might result in appreciably better learning by students. Conceptual rating directs primary attention to the quality and quantity of concepts presented in the drawing.

Figure 9 shows a drawing high in conceptual value. It presents significant concepts. It was rated "A" however because of structural characteristics. This drawing presents and includes the following concepts:

When charging:
- Electricity is directed toward the cell.
- Electrical energy is transformed into chemical energy.
- The positive pole turns from gray to red.
- Sulphuric acid is formed from lead sulphate.

When discharging:
- Electricity is set in motion by the cell.
- Chemical energy is transformed into electrical energy.
- Current flows in a direction opposite to that when charged.
- The positive plate changes in color from red to gray.
- Sulphuric acid changes to lead sulphate and water.

Figure 7 shows a drawing lower in conceptual value than Figure 9 and yet as good structurally. Figure 8 is poorer structurally than Figure 7 but presents the same concepts. Figure 11 was rated "A" but, conceptually, it could be improved.

It is evident that drawings can be executed and evaluated with different criteria in mind. The drawing can be good structurally with little detail and few ideas. It

can contain much detail, few ideas and be structurally poor. It can contain many

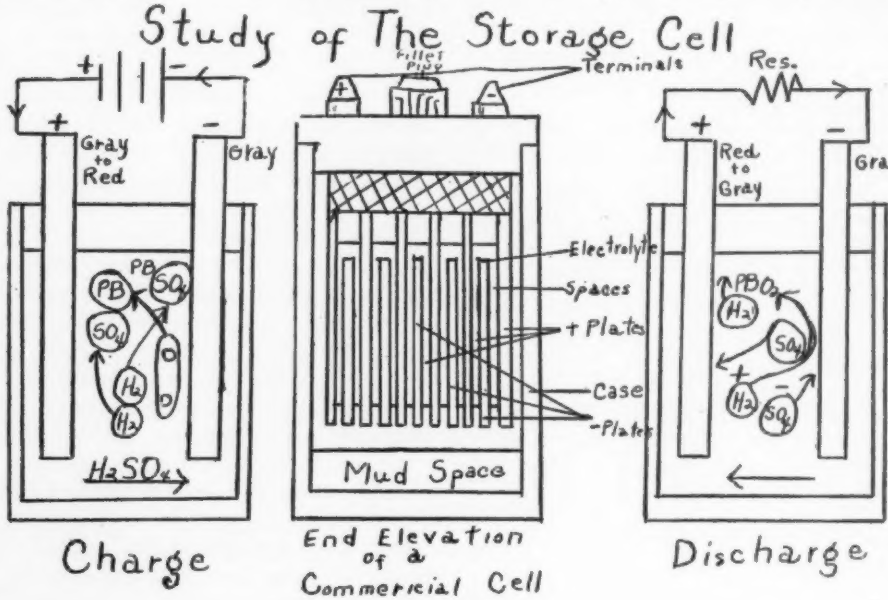

FIGURE 9

concepts and be strong or weak in terms of the other two factors mentioned.

How does application of these various criteria aid in learning? An hypothesis of this study is that inclusion of concepts in a drawing aids learning. Therefore, information on the following questions will be sought:

1. What kinds of concepts can be represented by drawing?
2. Of those kinds of concepts possible of representation by drawing, which will result in appreciably better learning when executed diagrammatically during the learning process?
3. What kind of learning is aided by drawings?

When studying the kind of learning there must be analysis and specification such as:

1. Association.
2. Comparison.
3. Differentiation.
4. Recognition and identification of class.
5. Abstraction.

Grading of scientific drawings can become evaluation when true standards are defined. The true standards are subjective values. Such values are the mental processes involved in learning. A key to these mental processes is the conceptual composition of a drawing.

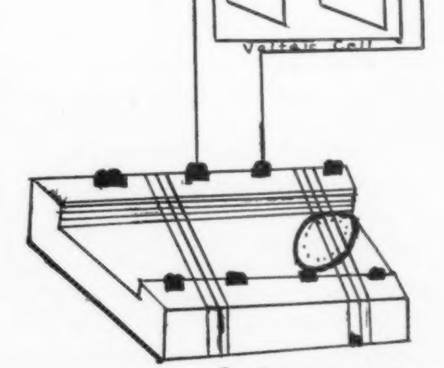

FIGURE 11

A PROFESSIONAL LABORATORY COURSE FOR SCIENCE TEACHERS

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USE OF APPARATUS, MATERIALS AND TOOLS IN THE SECONDARY SCHOOLS

In any physical science course in the modern secondary school one expects that apparatus, materials and tools of various kinds will be used. Our present educational theory and programs place considerable stress upon pupil experiences in the solution of actual problems. In the science courses many of these experiences are concerned with demonstrations, with laboratory "experiments," and more recently with pupil projects and individual problems. All of these involve the use of apparatus, materials and tools by pupils or by teachers or by both.

The using of apparatus and materials is an important phase of effective courses in secondary school sciences, whether these are planned for pupils who are going on to do advanced science work in college, or for those in general education who do not intend to take any further work in science. All pupils, whether going on to further work in science in college or not, are and will be concerned with a great many practical applications and problems involving apparatus and materials. Most important science concepts, facts, generalizations, or applications in general cannot effectively be explained or made as meaningful for any group of pupils without the use of apparatus and materials.

TEACHER NEEDS IN THE USE OF APPARATUS

Teachers of physical science need to be familiar with and have experience in using the apparatus, materials and tools which are important for working with boys and girls in science courses. They cannot effectively teach, guide or inspire the confidence of boys and girls without such ability and knowledge. They need it to be able to assemble, adjust, operate and repair apparatus used in demonstrations and laboratory work and to show pupils how to do many of these things. They need to be able to help pupils with a great variety of apparatus and techniques in connection with individual and group projects. They need to be able to improvise and construct apparatus and devices for various demonstrations and projects when equipment or funds are not available.

LACK OF EXPERIENCE BY TEACHERS IN THE USE OF APPARATUS AND TOOLS

That many teachers of science have been lacking in sufficient experience with such apparatus and techniques needed for working effectively with boys and girls has been felt by those who have worked with beginning teachers of science, or observed extensively in our public schools. Many science teachers have themselves expressed a need and desire for more experiences along these lines.

Actual performance tests and written statements of an unselected group of over two hundred teachers of science over the past three or four years have brought to light a surprising lack of ability on the part of many to do even simple laboratory tasks. Nearly half or more of these experienced or prospective science teachers, with majors in chemistry, physics or general science, indicated that they could not do or had not done such things as the following:

Use a battery charger
Use a lamp bank resistance
Replace fuse links in renewable fuses
Operate and adjust a portable motion picture projector
Set a maximum-minimum thermometer
Do simple glass blowing
Tin and use a soldering iron

Sharpen and use common tools
Test the electrical condition of a storage battery
Connect a relay
Demonstrate electrolysis of water
Develop and print pictures
Do simple electro-plating
Refill a fire-extinguisher

—as well as over a hundred other specific acts deemed important for secondary-school science teachers.

While it is, of course, not necessarily essential that a teacher be able to do any particular one of these, or of two or three hundred other specific acts, the lack of experience in general with such simple performances, as have been listed, indicates an unfamiliarity with the use of apparatus, materials and tools which is a tremendous handicap for good science teaching.

Of course, it is possible that all or most of such specific important abilities be "picked up" on the teaching job. The data of the above study, however, as well as the experience of many supervisors, indicate that experienced teachers are little more proficient in their use of apparatus, materials and tools than are those who have not been teaching science courses.

NEED FOR A PROFESSIONAL LABORATORY COURSE

Many students have "gone through" the science courses set up for a teaching major, including the laboratory work, and have not had contact or experience with most of the devices and techniques needed in connection with the teaching problems of secondary-school science courses. Most of the demonstrations included have been set up and performed by the college instructors or their assistants. Even in the laboratory, much of the apparatus is usually already set up, ready for the student to "make his observations." The usual laboratory courses in sciences in universities have other purposes and objectives than that of preparing students for high school teaching. For the objectives of these courses it is perhaps unnecessary that students have experience in the use of apparatus materials and tools needed for a high school teacher of science. The prospective secondary-school teacher of science, however, needs actual experience in working with the demonstrations, appliances and techniques which he will need to use in his teaching. Even working with the apparatus in "experiments" in a college laboratory has not usually been planned to give him experience in constructing and repairing the equipment needed for laboratory work in high school science courses.

It is desirable, therefore, that prospective teachers of science (and even those with teaching experience) get actual experience in using apparatus, materials and tools relating to the problems of secondary-school teaching. A course designed to provide such experiences has been offered in the Education Department of The Ohio State University for the past three summers, and is now also being put into one of the other quarters of the school year. The brief description of this course in the University Bulletin suggests the general nature of the course:

A LABORATORY PRACTICUM FOR SCIENCE TEACHERS (EDUCATION 681)

Students will have experience in working with such techniques as glass blowing, wood and metal working, chemical techniques, electrical circuits and devices, and photographic and visual aids as related to apparatus, materials and tools used in science courses in secondary and elementary schools. Students will make use of the techniques in assembling and constructing demonstration and laboratory apparatus for use in various science courses. Techniques and projects will be adapted to the needs and interests of individual students or teachers.

GENERAL PLAN OF THE COURSE

This course has been planned to provide the experiences in the use of apparatus for high-school science teaching, which each individual prospective or experienced teacher most needs. Since teachers obvi-

ously have had a wide range of different previous experiences and come with a variety of specific skills and information as well as of interests and needs a prescribed pattern of common experiences or "exercises" is inappropriate. Some are already quite expert in a particular phase, such as glass blowing, or electrical wiring, and it would be an ineffective teaching procedure and use of time to require such teachers to do the same things as those who have had no experience along these lines. Accordingly, the course is planned primarily as an "individual problem" course, with the experiences appropriate to the backgrounds, needs and interests of each teacher.

There are three main types of experiences provided for: (1) Working with "Techniques" such as electrical circuits or glass working; (2) "Individual problems" in constructing apparatus or trying out demonstrations or laboratory experiments; (3) Participation in a small group centered about a particular problem related to the use of the above phases in high school teaching situations.

DETERMINING INDIVIDUAL NEEDS

To get some evidence or indication of the particular phases upon which teachers need such professionalized experience, use is made of a three-step plan involving (a) "Background Inventory" test; (b) Experience Sheet; (c) A conference with each teacher on the basis of the data of the test and experience sheet.

The "Background Inventory" test is an objective instrument, the results on which have correlated well with those of actual performance tests in the use of apparatus, materials and tools. It serves particularly to show definitely what the individual knows (or doesn't know) about the use of apparatus and tools and helps him to recognize his own limitations and needs—and to be less sure that he "knows all about" even some simple phases.

The Experience Sheet, checked by each individual student, gives in easily available form the general types of laboratory techniques and experiences which he has had and those in which he feels he would like to get experience or explore further.

A conference with each student on the basis of these two instruments, furnishes the basis for setting up by mutual agreement what seems to be the desirable things for the individual to attack for the first few days at least. Further conferences, at least once each week, enable reports to be made on progress and particular problems encountered and plans made for further experiences.

THE "TECHNIQUES"

The experiences involving techniques referred to above have been temporarily grouped into the following (1) Glass working; (2) Metal working; (3) Wood working; (4) Electrical; (5) Chemical; (6) Biological; (7) Visual aids; (8) First aid and safety. Various phases of each of these are presented as demonstrations. Guide sheets have been prepared suggesting problems to be performed so as to get experience in the use of each technique, and including references for further information. About twenty such guide sheets are available and more are being prepared.

USING AND MAKING DEMONSTRATION AND LABORATORY APPARATUS

This is the "individual project" part of the course, and of course the projects are extremely varied. Students have worked on such things as making non photographic slides, setting up simple electrical demonstrations for general science classes, constructing an overhead projector, operating a relay, printing and enlarging pictures, making an apparatus for electro-magnetic demonstrations, preparing bacteria cultures, constructing and stocking aquaria, making a radio, operating photo-electric cells. Guide sheets have been prepared on many of the demonstrations and projects, giving

suggested ways for constructing or carrying out the project, references and possible pupil or class use. For those for which no guide sheets have been prepared, the student working on a project is asked to write up a guide sheet or to turn in notes from which one could be written.

CLASS GROUP PROBLEMS

The small problem groups work out in their own way suggested means for utilizing demonstrations, laboratory experiments, pupil projects and visual aids in the science classroom or in connection with club, assembly or "open house" programs. Reports are made to the entire group by demonstrations, talks, panel discussions, or mimeographed suggestions.

CLASS LIBRARY

A library is gradually being built up, so that references and high school texts are available for use in the laboratory, or in a room immediately adjoining. Here the students may find a wide range of demonstrations, experiments, projects and formulae on a variety of topics. These are available, when he needs them in working on his projects or techniques, without having to go across the campus to a special library. Professional books are also available for the use of individuals or of the small problem groups. A variety of pamphlet and bulletin board material is also available. These references and supplementary materials are used only in the laboratory library and are not checked out for overnight use or longer.

REACTIONS OF STUDENTS

Both experienced and inexperienced teachers have in general been generous in voicing approval of the opportunities provided in this professional laboratory course. The chance to work on problems of direct concern to actual "here and now" teaching situations in their own classes, rather than merely theorizing about them has been particularly appreciated by the experienced teachers. The inexperienced teachers have stressed the value of being able to work on demonstrations, techniques and projects upon which they were "shaky" or unfamiliar, and the feeling of security which they derived from actual accomplishment with prospective teaching problems.

AN EXPERIMENT IN THE TEACHING OF GENETICS, WITH SPECIAL REFERENCE TO OBJECTIVES OF GENERAL EDUCATION

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The investigation, upon which this report is based, grew out of the current interest in general education. It had as its aim the evaluation of changes effected in certain college students during the presentation of a teaching unit, prepared with objectives consistent with those of general education. This unit dealt with the biological backgrounds of racial differences and similarities and their relation to some racial problems in the United States. For purpose of comparison and control, other students were taught a unit of genetics, approaching the study of the science from a more traditional point of view. For both groups of students certain background traits, which were found to affect the final test scores, were statistically controlled.

During the preparation of the experimental unit the following considerations were kept in mind.

A common phenomenon which develops during the growth of totalitarianism is the suppression of liberties of certain minority

groups, frequently called, "racial groups." During recent years movements for suppression of the liberties of such minority groups have appeared from time to time. These movements are frequently based on false notions of racial superiority or inferiority. In addition to such movements, we have the continued presence of racial problems in our country, as exemplified by the periodic introduction of anti-lynching legislation in the Congress.

In a democracy certain principles involving the recognition of the rights of others stand out. Any program of general education in a democracy should be formulated with due regard for these principles. From them two were selected as objectives in the preparation of the experimental unit. They are:

1. Each individual, while in constant and essential relationship to the society in which he lives, has a unique value.
2. The entire range of the behavior of an individual involves interaction with other individuals.[1]

It thus becomes an objective of education, not only to allow for the fullest realization of the worth of the individual, but also to develop in each a recognition of the worth of other individuals, even though their backgrounds and ideals may differ from his own. In the preparation of the experimental unit of instruction it was hypothesized that instruction dealing with the biological backgrounds of racial differences and similarities might result in expression of greater tolerance for peoples whose national origins differ from those of the students concerned.

From the field of genetics the following generalizations were selected as contributing to an understanding of the biological backgrounds to which reference has just been made

The difference between one race and another is usually not a matter of the possession by one or another of certain unique characters.
Races differ largely in terms of the relative frequency of genetic factors which are common to all of them.
Because of the nature of the process of mutation and the operation of chance most racial differences are trivial; the probability of socially significant differences between races is low, but it is not zero.[2]

To the generalizations just quoted others were added. These, selected from the field of anthropology, were:

National, or ethnic, groups are usually not racial groups
Present national groups are very heterogeneous from the standpoint of racial origin.
Pure races of mankind are becoming increasingly infrequent.

Materials presented to the students who constituted the experimental group were selected when, in the opinion of the instructor, they contributed to the development of these generalizations and through them to the realization of the quoted objectives of general education. These materials transcended the ordinary boundaries of subject matter, drawing from such fields as anthropology, economics, the history of the migrations of peoples, racial problems and from psychology, as well as from the study of heredity. As a result of the needs and interests of the students, as interpreted from their responses to the initial tests, their questions and comments, these materials were modified as instruction progressed.

In the preparation of the materials to be presented to the students who constituted the control group a book[3] was frequently consulted. This unit was a logical organization of subject matter from the science of genetics. The materials pre-

[1] Eurich, Alvin C. (Chairman), *General Education in the American College*, National Society for the Study of Education. *Thirty-Eighth Yearbook, Part III;* Bloomington, Illinois: Public School Publishing Company, 1939. p. 10.

[2] Committee on the Function of Science in General Education, *Science in General Education*. Progressive Education Association. New York: D. Appleton-Century Company, 1938. p. 539.

[3] Sinnott, E. W., and Dunn, L. S. *Principles of Genetics* (Second Edition). New York: McGraw-Hill Book Company, 1932. p. 441.

sented were modified by interpretation of student needs as with the other group. With the control students, however, the emphasis was placed upon the learning of the facts and principles of genetics, the biological backgrounds of racial differences and similarities arising only incidentally and with considerably less frequency than with the experimental group. Table I shows the approximate fraction of the total time which each group spent with materials from the several areas of subject matter from which the units were taken. The total time of instruction for both experimental and control groups was three weeks, each with five class periods of fifty minutes duration.

The experimental teaching was carried on in the Western Washington College of Education at Bellingham, Washington. All students, largely freshmen, enrolled in their course entitled, "Science and Civilization," were used in the experiment. This provided an experimental group of ninety students and a control group which numbered one hundred four students.

In evaluating changes effected in students by instruction in a unit of subject matter, it has usually been the practice to measure change in knowledge, or knowledge gained. That there are other changes of equal, or greater, importance has long been recognized. Frequently the concommitants assumed to accompany growth in knowledge are considered the justification for this or that subject. In evaluating changes resulting from instruction in the units previously described, three criteria were adopted. These are:

1. Growth in "knowledge and insights."
2. Growth in "ability to use scientific method."
3. Changes in "attitudes." [4]

Three tests were used in the evaluation of growth in knowledge and insights. Two of these, "Selection of Facts, forms I and II," were prepared as follows. From the files of the Cooperative Test Service [5] all items dealing with genetics were taken. To these were added a few which had been prepared by the experimenter and adopted after consideration and revision by three experienced college science teachers. All items were then administered to an unselected group of students from the same college as that used in the experiment. On the basis of the results, two forms were prepared so that the means and standard deviations were approximately equal. The third test was a true-false test. The items used had been prepared by the experimenter and had been validated over a period of years in his courses in genetics. Since this process was completed prior to

TABLE I

APPROXIMATE FRACTION OF THE TOTAL TIME SPENT ON EACH OF SEVERAL SUBJECT MATTER AREAS

Area of Subject Matter	Experimental Group	Control Group
Anthropology (Including the genetics of Racial differences and similarities)	.20	.07
Psychology (Intelligence measurement)	.07	.06
History (Migrations of peoples)	.11	.00
Statistics (Variability)	.11	.10
Economics (Income level of various classes)	.07	.05
Heredity (Genetics)		
Physical Basis of Heredity	.16	.32
Factor Hypothesis	.18	.26
Human Heredity (Exclusive of Race)	.10	.14

[4] Laton, Anita D., and Bailey, Edna W. *Suggestions for Teaching Selected Material from the Field of Genetics.* Bureau of Educational Research in Science, Teachers College, Columbia University. Monograph Number One. New York: Bureau of Publications, Teachers College, Columbia University, 1939. p. 29.

[5] Barrows, W. M., *et al. Cooperative Zoology Test, Part C;* Forms of 1934, 1935, 1936. New York: Cooperative Test Service.

the inception of this experiment, the test bore no direct relation to it. "Form I—Selection of Facts," was administered before the teaching period to one experimental and one control section, "Form II" to another experimental and control section of the class. Both forms were administered finally to all four sections. The true-false test was administered at the beginning and at the end of the teaching period. Scattered throughout the true-false test were fifteen statements of common superstitions regarding heredity. A separate analysis was run on the data collected through the use of these statements.

In the examination of change in ability to use scientific method five tests were used. Two of these, "Application of Principles, Forms I and II," were prepared and administered in a manner identical with that described for the Selection of Facts tests. Two forms of a test involving interpretation of data were prepared by the experimenter and subjected to the criticism of the science teachers mentioned above. These were also standardized on the group of unselected students used in standardizing the other tests. Finally a test involving the evaluation of authorities was prepared by the experimenter and subjected to criticism as previously described. This test was then administered to the students of an advanced course in genetics and as a result items which proved ambiguous were deleted. This test listed forty-five statements, "now or formerly believed by many people." The students were asked to classify the evidence supporting the belief in the truth of each statement as based primarily on: (1) tradition, (2) observation or (3) experimentation.

One test used in measuring changes in attitudes was "Opinions on International Questions."[6] A second consisted of statements favorable to or opposed to each of several nationalities. The students were asked to accept or to reject each statement in terms of a five point scale. All statements were scored favorably to the nationality concerned.

During the experiment certain data were collected from the students. These data were: age, claimed nationality of ancestors, school year, sex, intelligence, and the initial and final test scores on the several tests used. The correlations between each of these characters and the final scores on the tests were so low as to be of doubtful significance, except in the cases of the initial scores and of intelligence. Therefore, the initial scores made on a given test and the intelligence scores were used as basic matching characters in the analyses of data.

The statistical technique used in the analyses is that described by Johnson and Neyman.[7] In the analyses the effect, of the basic matching characters on the final measurement is predicted from the multiple regression equations. Hence, the need for individually matched pairs of students disappears. Another advantage of the technique is that it describes the range, on the background characters selected for matching, wherein detected differences are to be considered as significant. This range is called the region of significance. The region of significance varies from test to test. There may conceivably be two regions of significance; one wherein the differences favor the experimental group and the other wherein the differences favor the control group. In the analyses reported below this situation did not arise, as in those cases where two regions of significance were indicated, the one favoring the control group lay far from the distribution on the basic matching characters.

Table II shows the results of the analyses.

[6] Association Press. *Opinions on International Questions, Form A.* New York: Association Press (year of publication not stated).

[7] Johnson, P. O., and Neyman, J. "Tests of Certain Linear Hypotheses and Their Application to Some Educational Problems." *Statistical Research Memoirs* 1:72–93; June, 1936.

As is indicated in the tabulation a total of nineteen analyses were completed. Of these seven indicate, at the significance level $P = .01$, regions of significance wherein the differences are favorable to the experimental group. Regions of significance, at the level $P = .05$, wherein the differences are favorable to the experimental group are indicated by three more of the analyses. The regions of significance are distributed throughout the three classes of evaluative criteria. Of the remaining nine analyses seven show differences which favor the experimental group, while two show differences which favor the control group. There are no regions of significance, at the level $P = .05$, with differences favoring the control group. An examination of the locations of the regions of significance shows that they occur with greater frequency towards the upper end of the intelligence distribution. Hence, the brighter students profited more if members of the experimental group than if members of the control group.

TABLE II

SUMMARY OF THE ANALYSES OF DATA

Opposite each test is listed the level of significance at which the region emerges. At all higher levels of significance a region of significants exists, becoming increasingly larger as the level is raised. A low level of significance, $P \leqq .05$, is usually considered as significant.

Final Criterion	Probability Level, at which Region of Significance Emerges	Group Favored by the Value of the Differences Within the Region of Significance
Growth in Knowledge and Insights		
Selection of Facts, I	$.2 > P < .1$	Control
Selection of Facts, II	$.05 > P > .02$	Experimental
Selection of Facts, I or II	$.1 > P > .05$	Experimental
True-False	$P < .001$	Experimental
Superstitions	$P < .001$	Experimental
Growth in Ability to use Scientific method		
Application of Principles, I	$.5 > P > .4$	Control
Application of Principles, II	$.05 > P > .02$	Experimental
Interpretation of Data, I or II	$.01 > P > .001$	Experimental
Evaluation of Authority	$.02 > P > .01$	Experimental
Changes in Attitudes		
Opinions on International Questions	$.01 > P > .001$	Experimental
Opinions on Imperialism	$P < .001$	Experimental
Attitudes towards the Following Peoples (Combined)	$P < .001$	Experimental
Attitudes towards Orientals	$.01 > P > .001$	Experimental
Attitudes towards Jews	$.1 > P > .05$ *	Experimental
Attitudes towards Italians	$.1 > P > .05$ *	Experimental
Attitudes towards Nordics †	$.1 > P > .05$	Experimental
Attitudes towards Scandinavians †	$.2 > P > .1$	Experimental
Attitudes towards Latin Americans	$.2 > P > .1$	Experimental
Attitudes towards Americans †	$.4 > P > .3$	Experimental

* These analyses approach the level P .05 very closely.

† Since practically all of the students were of national extraction popularly classed as "Nordic," many of Scandinavian descent and all were American citizens, scores in these three categories were treated negatively.

Item analyses show that the students of the control group achieved better on items relating to the details of the mechanical aspects of genetics. The ratios of the differences to their standard errors were low, however, rarely exceeding a critical ratio of 2.5. The experimental group excelled

on items relating to the genetics of racial differences and similarities, and to human heredity, exclusive of race. The ratios of the differences to their standard errors were much higher, frequently exceeding a critical ratio of 2.5.

The educational implications of the findings of this study may be stated as follows:

The data indicate that growth in ability to use scientific method and changes in attitudes can be effected in students without loss in growth in knowledge and insights. However, the areas of subject matter wherein such growth in knowledge occurs do not necessarily coincide with areas wherein such growth occurs when the material is taught purely for the purpose of increasing students' knowledge.

Instruction directed towards the better understanding of practical problems of everyday life can be so taught as to effect changes in ability to use scientific method which are deemed desirable by those concerned with the preparation of the units of instruction.

The changes effected in knowledge and insights radiate into the area of specific attitudes, even though these are not taught directly. The change in attitudes is greater, however, when instruction is so planned as to foster change than when such change is left to chance. The direction of change in attitudes is that for which the instruction is planned.

The experimental unit, prepared with objectives consistent with those of general education, was the more effective with the brighter students. Some general education programs have been set up to meet the needs of college students who are considered to be of less than college caliber. Should subsequent investigations with units in other areas show similar findings, one might question the validity of a policy which limits the general education program to the less able students.

INSTRUCTIONAL PROBLEMS OF GENERALIZED SCIENCE IN THE SENIOR HIGH SCHOOL *

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Within recent years a significant trend in the curriculum of the senior high school has developed an integrated course in physical science. Changes in the objectives and emphasis of instruction at this level have brought many educators to the conclusion that such integrated courses in science are better suited to a certain large group of students than are the conventional courses in physics and chemistry. Recognition of this new aspect of the curriculum introduced the problem as one worthy of study in the field of science education.

THE PROBLEM

The problem in this investigation has a dual purpose. It is planned: first, to show how the instructional problems of the general science course in the senior high school are being met at this time; second, to make a comparative study of the scores made by students of senior high school general science, and those of physics, chemistry, and biology on two tests devised for this study.

SOURCES OF DATA

Subjects involved in the study composed the 270 teachers who answered the questionnaire from which the data in Chapter II were obtained. Other participating subjects included 4,239 students representing principally the tenth, eleventh, and twelfth grades in 85 schools from 31 states. From this group of students, 98 classes were paired so that the teacher of senior science in one particular school would also be

* Abstract of a doctoral dissertation, George Peabody College for Teachers, 1939.

teaching one other class in the sciences being considered in this study.

Separated according to the science subjects in which these students were enrolled in the 98 paired classes were 1,162 students in senior science, 521 in physics, 459 in chemistry, and 272 in biology.

METHOD OF PROCEDURE

The procedure is composed of two major divisions. A questionnaire on the integrated physical science course contained questions relative to the school, the senior science teacher, the senior science course, the students enrolled in the course, credit allowed toward graduation, and teaching procedure. The 270 usable returns were obtained after having first been in communication with these teachers by postal card to obtain their permission to send them the one page printed questionnaire.

The testing program was conducted during the early part of the 1938–1939 school year in 93 high schools. At the close of the experiment 85 schools had completed the tests; they are represented by the 4,239 students. By an objective sampling of the index of the textbook, *Senior Science*, prepared by Bush, Ptacek, and Kovats, topics were obtained on which a preliminary science test was constructed and given to students in the Peabody Demonstration School. After due analysis of the per cent of correct responses on each question a final form of the test, composed of approximately one-half of the preliminary test questions, was arranged in order of difficulty. The final or printed form of the test is referred to as the Science Inventory Test.

Another test, constructed to determine the degree of interest students manifested in ten major units of study, was given to the same students. This test had as a basis sixty selected articles from magazines indexed in the *Reader's Guide*. These articles were annotated and arranged into ten units without any heading to designate the units to which the article had been assigned.

These two tests were administered at the opening of the school year before pupils had much of an opportunity to study the science for which they had enrolled. At the close of the semester the same tests were given again.

SUMMARY OF THE FINDINGS

A resume of the findings from the questionnaire indicate that:

1. The majority of the schools now teaching general science in the senior high school instituted the course in 1937–1938.

2. Out of 270 reporting teachers of senior science approximately 62 per cent had a bachelor's degree, and 37 per cent a master's degree.

3. Chemistry was the predominating major and mathematics was the predominating minor in the college training of these teachers.

4. Almost 50 per cent of the 242 schools offering senior science in the upper grades also teach ninth grade general science.

5. Biology is the tenth grade science offered in 74 per cent of the cooperating schools teaching senior science.

6. Out of 270 schools, 218 offer chemistry as well as a senior science course in senior high school. Approximately 55 per cent offer their chemistry to the eleventh and twelfth grade students.

7. Out of the 270 schools, 221 offered physics as well as senior science. Approximately 50 per cent offer it to the eleventh and twelfth grade students.

8. Approximately 13,000 students were enrolled in senior science in the schools participating in the questionnaire study in 1937–1938.

9. Approximately 80 per cent of these schools did not have individual laboratory work in their senior science course.

10. The average number of demonstration experiments per year for senior science was thirty-five.

11. Only 6 of the reporting schools offered senior science for less than one unit of credit towards graduation.

12. In the teaching schedules of these senior science teachers the subjects appearing with the greatest frequency are physics, chemistry, junior high general science, and mathematics.

13. It was the opinion of these teachers that students not preparing for college work would find senior science more profitable than the special physical sciences. Those preparing for college should take the special sciences such as physics and chemistry.

Results from the analysis of the textbooks in the integrated physical science indicate that:

1. Two significant trends are recognized in the published works representing the integrated physical sciences on the senior high school level.

   a. One may be regarded as a means of imparting practical information in the sciences by stressing the applications of science rather than theory.

   b. The other is an integration of the theoretical aspects of physics and chemistry with the idea of improving the educational opportunities of science students.

2. Two textbooks, as far as the writer can ascertain, represent the integrated physical sciences for the senior high school up to June, 1939.

   a. *Senior Science,* prepared by Bush, Ptacek, and Kovats, presents the applications of science without emphasizing theory. Those students whose formal education ends with high school work are given first considerations. The writer's analysis of the book shows approximately 14 per cent of the space devoted to "Home Equipment" and 13 per cent to "Transportation." General applications of the sciences to the students' environment rather than theoretical interpretations have received major emphasis. The social implications of the topics considered are treated from the standpoint of scientific consumers of the products of science.

   b. *Our Physical World,* written by Eckles, Shaver, and Howard, represents the fusion of the theoretical material from the physical sciences with somewhat less emphasis on applications. Attention is focused on the outcomes of the material to the student with regard to his attitude and appreciations as well as to techniques and skills. Modern theories of the structure of matter are interpreted in the light of modern physics and chemistry. Analysis of this book shows 11 per cent of the space devoted to "Theoretical Chemistry," and 10 per cent to "Student Activities in the Laboratory."

Findings from the Science Inventory testing program indicate that:

1. Even though they represent corresponding age levels, students enrolled in senior science appeared to have less knowledge of applied science at the beginning of the school year than the groups in physics and chemistry. If one considers the Science Inventory Test as a valid measure of intelligence, the lower ability students were found in the senior science course.

2. Judged by the difference between the means of the first and second semester scores on the Science Inventory Test, the senior science group made the most significant gain. In the light of the preceding statement this significant increase of senior science scores can be attributed to the fact that all students took a senior science test —not a test devised for theoretical physics, chemistry, or biology.

3. The widely scattered sampling of schools and adequate numbers resulted in distribution curves indicating insignificant skewness.

4. The senior science group made the most consistent gains in scores on the Science Inventory Test from one percentile to the next. This would indicate, according to the writer's interpretation, that this course contained the most applicable information for the Science Inventory Test.

5. A comparison of the mean scores

according to the grade in high school indicates that the greatest increase in mean score occurred in the twelfth grade; therefore, the logical grade in which to institute this senior science course is probably at the twelfth year level.

6. The consistency of gains noted from the tenth to the ninetieth percentiles in the twelfth grade gives supporting evidence that senior science will probably produce better results when offered in the twelfth grade.

7. Correlations of the first semester scores with the second semester scores on the Science Inventory Test for the four sciences give the following results: physics, .90–.001; chemistry, .84–.009; senior science, .77–.008; biology, .83–.013. The coefficients obtained indicate that this test is measuring some aspects of intelligence rather consistently.

8. Judged by the correlations obtained, the slight deviations in dispersion, and the reliability coefficients obtained through the "split-half technique," the Science Inventory Test and the Science Interest Test show very satisfactory reliability.

9. Significant differences existed between the boys' and the girls' mean semester scores in the Science Inventory Test and indicated that the boys made better grades in science.

Findings for the Science Interest testing program indicate that:

1. The students enrolled in senior science began the school year with a greater interest in reading magazine articles dealing with the applications of science that were used in this test.

2. From the interest scores made, it appears that senior science is slightly more capable of inducing greater interest in these units of study than physics, chemistry, and biology.

3. A comparison of the interest scores by grades suggests that the twelfth grade is probably the correct grade level for this generalized course in senior science although the eleventh grade might reasonably share in interests in this generalized course. Immaturity of science interests indicates that students of the tenth grade should probably be excluded from this course.

4. Measures of dispersion indicated no marked effect on the homogeneity of students' scientific interests as a result of the instruction given in the three grades.

5. Correlations of individual interest scores made the first and second semesters indicate values of statistical significance, but point to a none too stable individual interest.

6. No significant difference was indicated by a comparison of the central tendency interest scores made by the two sexes.

TOPICS FOR FURTHER STUDY

Other topics worthy of investigation, in the opinion of the writer, have presented themselves as this study has been in progress:

1. A comparative study of the success attained by senior science students that enter college classes.

2. The development of the scientific attitude of students in integrated science courses compared with those students enrolled in physics, chemistry, and biology.

3. A basic study of topic interests on the senior high school level, with the idea of selecting the most appropriate content material for an integrated physical science course for the twelfth grade.

OUTCOMES OF A STUDY EXCURSION *

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Despite widespread and growing use of the study excursion as an educational enterprise, little has been done to measure its outcomes by the techniques of recognized evaluation procedures. With the growth of interest in general education and the consequent enlargement of educational purposes, the study excursion is gaining recognition as one procedure for attaining the objectives which general education recognizes. Educational literature essaying subjective evaluation of study excursions lists outcomes which are very similar to the professed purposes of the proponents of general education. The purpose of this study is to measure certain of the possible outcomes of the 1938 Lincoln School (of Teachers College, Columbia University) Senior Class study excursion and to investigate some relationships among those outcomes, in order to test the thesis that the study excursion is one valuable technique for implementation of the aims of science in general education. The outcomes concerning which measurement was attempted were as follows:

1. Growth in understanding of the problems of soil erosion and land management and growth in understanding of the procedures and processes used to convert energy of falling water into useful electrical energy.
2. Changes in attitude toward the following public problems:
   a. Public Relief.
   b. Unlimited Individual Initiative in Farming.
   c. Socio-economic Planning.
   d. Conservation.
   e. Private Ownership of Utilities.
3. Changes in opinions regarding the following propositions:
   a. An individual farmer should possess the sole right to make decisions in regard to the farming practice on his own farm.
   b. It is wise for the government to lead in the development of the kinds of social-economic planning carried on in the Tennessee Valley.
   c. It is wise for the government to enter the power business in competition with existing private power companies.
   d. Communism, civil war, people's fronts, national governments, and central economic planning, are all different forms of a revolt against private monopolies.
   e. Planning is not something new; it is the very stuff of which civilization has been made.
   f. We are sure to have for the next generation an increasing contest between those who have and those who have not.
   g. Governments should come to the assistance of people who have low standards of living, even if those people are not enthusiastic about receiving such assistance.
4. Growth in ability to identify evidence of poor land management and procedures for better land management.
5. Growth in ability to recognize the application of principles of land management.
6. Growth in ability to generalize in regard to land management.
7. Growth in ability to recognize the application of principles of power production.
8. Growth in ability to generalize in regard to power production.
9. Evidences of other growths, such as in reflective thinking and in personal relationships.

Twenty boys and twenty-six girls who participated in the Lincoln Senior Class Study Excursion to Tennessee and Georgia in 1938 were the students whose scores on certain instruments of evaluation form the basis for this report. It was necessary to develop ways and means to measure the outcomes proposed for evaluation. Since differences—in the sense of growths, losses and changes—were the objectives, it is essential to recognize that the measurements should have been made both "before" and "after" the study.

An information test was devised in order to measure outcome number one. The same test was used "before" and "after" and justification for this procedure was obtained by a minor piece of research.

Outcome number two was measured through use of two forms of "A Scale for Measuring Attitude Toward Any Institution" by Kelley and Remmers.

The third outcome concerning which

* Abstract of doctoral dissertation, Teachers College, Columbia University, 1939.

measurement was attempted, was similar to the second and was planned so in order that data on the validity of the Kelley-Remmers Test might be secured. Spontaneous statements from each student with reference to the seven listed issues were solicited "before" and "after." Measurement of these was attempted by serial or order-of-merit arrangement of the statements—a process usually called ranking.

The fourth, fifth and sixth outcomes were measured through use of a specially devised instrument. Slides for projection were made from diagrams showing a section of badly managed land and the same land after procedures for better land management had been employed. Capital letters were placed on the slides so that various features could be identified. Students were asked to identify the lettered features, to indicate locations where they believed principles of land management (chosen from a list of twenty-five) were illustrated and to make generalizations in regard to each lettered location. Judges decided the correct answers for the identification portion of the test and for the application of principles portion. When they disagreed, values were weighted approximately in proportion to the number of judges who did agree on an answer. The generalizations were measured by the ranking technique.

Outcomes seven and eight were measured by a technique similar to the above, using a diagram of a water turbine-generator plant.

Outcomes other than the above were evaluated through examination of student diaries, teachers' anecdotal records and the author's observations.

Evidence is submitted to show that the study excursion resulted in reliable changes as follows:

1. A marked gain in information.
2. A change in the group's attitude toward unlimited individual initiative in farming.
3. A change in the group's attitude toward private ownership of utilities.
4. A change in opinion with reference to the proposition that an individual farmer should possess the sole right to make decisions in regard to the farming practice on his own farm.
5. A gain in ability to identify evidence of poor land management and procedures for better land management.
6. A gain in ability to recognize the application of principles of land management.
7. A gain in ability to generalize in regard to land management.
8. A gain in ability to recognize the application of principles of power production.
9. A gain in ability to generalize in regard to power production.

Evidence is submitted showing an increase in the inter-correlations among the Kelley-Remmers attitude scores which although not reliable according to the standard chosen is in a direction which shows increased relationship.

Diary excerpts and anecdotal records are used as evidence that the study excursion provided for exercise of ability to think critically, for adjustment in personal relations, and for vitalization of the emotional content of the work.

These results justify the conclusion that the study excursion, as an educational enterprise, is capable of producing outcomes in addition to gain in factual knowledge, outcomes which current educational theory is emphasizing as increasingly important; that it is an effective procedure for bringing the individual into contact with the culture which is his birthright in such fashion as to widen and deepen his consciousness of his relation to the life of the past, the present and the future, and to aid in the development of those attributes which are most needed if he is to play intelligently his personal role in the drama of cultural continuance and cultural change;[1] that, in short, the study excursion is one effective procedure for implementation of the philosophy of general education and the aims of science in general education.

[1] Powers, S. R. (Chairman). *Progress Report of a Committee Appointed to Consider a Projected Proposal for an Enlarged Program for General Education.* Teachers College, Columbia University, 1937.

A SURVEY OF THE CONSERVATION INFORMATION POSSESSED BY PUPILS IN MISSOURI HIGH SCHOOLS *

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The fact that our natural resources are being depleted rapidly is so impressed upon us today that we are tending to become conservation conscious. A survey of the literature on the subject reveals that certain national leaders have long been aware of the problem and that they have made concrete efforts to effect its solution.

That education is one of the chief factors in the conservation movement is now definitely recognized. Gable,[1] Studebaker,[2] and Pack [3] particularly emphasize its importance.

STATEMENT OF THE PROBLEM

This investigation has sought to determine the extent to which the present school program in Missouri is educating children in the facts, principles, and problems of conservation. The study was limited to the renewable resources of wildlife and of soils. For purposes of the investigation the wildlife section was considered as including animals, forests, and plants other than forests.

THE GENERAL PROCEDURE

Since no test of conservation was available, it was necessary to construct one. This took the form of a comprehensive multiple-choice type test,† containing one hundred items and a questionnaire dealing with school subjects and activities in which pupils engaged.

In view of the fact that work was being done in connection with a state conservation program by a number of members of the teaching and research staff in the University of Missouri, it was decided that these individuals were highly competent to say what principles and facts were sufficiently verified as controlling sound conservation practises. These men were interviewed and asked to prepare a list of statements of principles and facts, and of common misconceptions dealing with the two major fields to be considered.

The various statements of principles and facts together with those of common misconceptions were arranged in such a way that each statement was followed by four, as nearly as possible, plausible completions, only one of which was correct. The pupil was directed to select the one completion which in his judgment correctly completed the statement.

In addition to his responses to the test items, each pupil was requested to give the following pertinent information:

1. Year in school.
2. Subjects taken and activities in which pupil had engaged.
3. Subjects and activities considered helpful in answering the test items.
4. Subjects or activities other than those listed on the test which were considered as having been definitely helpful in answering the test items.

The test was administered to 2,775 pupils located in twelve schools in the state. These schools were so selected as to represent rural, small city, suburban, and large city communities.

The performance of the various groups

* Abstract of doctoral dissertation, University of Missouri, 1939.

[1] Gable, Charles H., *Teaching Conservation.* The American Nature Association, Conservation Bulletin No. 3, p. 5.

[2] Studebaker, J. W., *Conference on Conservation Education—Summary of Proceedings.* United States Office of Education, Bulletin, September, 1937, p. 1.

[3] Gable, Charles H., *Op. cit.,* Foreword.

† Copies of the test may be secured from the author.

and sub-groups was studied by reference to measures of central tendencies and dispersions. Separate distributions were made of the scores of the pupils in the entire group of cooperating schools, of the scores of pupils in each of the school years or grades represented, and of the scores of pupils in the entire group of cooperating schools classified according to community type. Distributions were also made showing performance on the four divisions of the test and the extent to which school subjects, organizations, and out-of-school agencies are contributing to conservation information.

TABLE I

A DISTRIBUTION OF THE SCORES MADE BY ALL PUPILS ON THE CONSERVATION INFORMATION TEST

Score	Number of Pupils Scoring
81–84	2
77–80	17
73–76	53
69–72	120
65–68	231
61–64	339
57–60	394
53–56	437
49–52	360
45–48	285
41–44	199
37–40	125
33–36	104
29–32	53
25–28	25
21–24	13
17–20	6
13–16	3
9–12	1
5–8	6
1–4	2
Total	2775
Mean	53.98
S.D.	10.78
Median	54.88
Q_1	47.23
Q_3	61.83
Range	4–83

Table reads: A score of 81–84 was made by 2 pupils, *etc.*

THE EVIDENCE

A summary of the findings of this investigation follows:

1. Examination of the data presented in Tables I and II shows that of the conservation information considered desirable for high school pupils of Missouri to possess, there is approximately 54 per cent mastery. The degree of increase of the median and mean scores from the freshman through the senior year may indicate that the increase is due more to maturity of the pupil and his incidental acquisition of information than to the wise use of teaching materials dealing with conservation.

2. In so far as this test measures conservation information, and in so far as this group is typical of high school pupils of Missouri, the pupils of rural communities are slightly superior to those of either the small city or city and suburban communities. Pupils residing in city and suburban communities are slightly superior in conservation information to those living in the small cities of the state. Table III presents data for the three groups.

3. The data for achievement on the four divisions of the test, by year in school and for a sample group of 677 pupils, are shown in Table IV.

To the extent that results on this test are typical, high school pupils of Missouri have a greater fund of information about soil and forest conservation. Pupils of each of the four years have a greater fund of information about soil conservation than of any other division.

There is a gain in information from year to year on each of the four divisions. The greatest amount of gain from the freshman through the senior year is in soil conservation, while the smallest gain over the four year period is in forest conservation information.

The greatest amount of conservation information possessed by any group is that of the seniors in soils. The smallest amount is that of the freshmen in conservation information about plants other than forests.

4. The data showing subjects and activi-

ties participated in and the per cent of those participating who considered the subject or activity as having been helpful in furnishing information necessary to answer the test items are presented in Table V. It will be noted that some of the subjects and activities ranking highest in percentage helpfulness are not necessarily being engaged in by the greatest number of pupils.

5. Other subjects and activities which were not listed in the questionnaire but which were added by pupils as having been definitely helpful in furnishing information necessary in answering the test items are shown in Table VI.

CONCLUSIONS AND RECOMMENDATIONS

1. On the basis of the data presented in this study it is reasonable to conclude that there is evidence of fairly uniform mastery of the conservation information contained in the Conservation Information Test. If one may assume, however, that 58 per cent mastery by the end of the senior year of the high school period represents inadequate understanding of the facts and prin-

TABLE II

A DISTRIBUTION OF THE SCORES MADE BY THE FRESHMEN, SOPHOMORES, JUNIORS, AND SENIORS ON THE CONSERVATION INFORMATION TEST

Score	Freshmen	Sophomores	Juniors	Seniors	Total
81–84			2		2
77–80	1		8	8	17
73–76	7	9	14	23	53
69–72	18	21	33	48	120
65–68	36	33	71	91	231
61–64	82	66	80	111	339
57–60	96	79	106	113	394
53–56	158	93	97	89	437
49–52	140	77	79	64	360
45–48	131	53	58	43	285
41–44	83	42	41	33	199
37–40	78	24	14	9	125
33–36	55	24	14	11	104
29–32	32	9	6	6	53
25–28	13	7	3	2	25
21–24	8	4	1		13
17–20	2	3	1		6
13–16	2		1		3
9–12			1		1
5–8		4	1	1	6
1–4		2			2
Total	942	550	631	652	2775
Mean	50.16	52.64	56.20	58.44	53.98
S.D.	10.55	11.70	10.50	9.82	10.78
Median	50.91	54.12	56.92	59.40	54.88
Q_1	43.19	46.39	49.85	52.62	47.23
Q_3	57.18	60.56	54.26	65.31	61.83
Range	15–80	4–76	5–83	6–79	4–83

Table reads: A score of 73–76 was made by 7 Freshmen, 9 Sophomores, 14 Juniors, 23 Seniors, etc.

TABLE III

A DISTRIBUTION OF THE SCORES MADE BY THE PUPILS CLASSIFIED ACCORDING TO TYPE OF COMMUNITY

Score	Rural	Small City	City and Suburban
81–84		1	1
77–80	7	6	4
73–76	22	25	6
69–72	41	54	25
65–68	67	108	56
61–64	94	140	105
57–60	97	168	129
53–56	97	209	131
49–52	97	146	117
45–48	65	117	103
41–44	50	82	67
37–40	22	68	35
33–36	21	56	27
29–32	4	37	12
25–28	4	13	8
21–24		8	5
17–20	1	2	3
13–16		2	1
9–12		1	
5–8		6	
1–4		2	
Total	689	1251	835
Mean	56	53.24	53.4
S.D.	10.3	11.9	10.2
Median	56.31	54.65	54.20
Q_1	49.22	46.20	46.97
Q_3	63.53	61.61	60.63
Range	18–80	4–81	17–83

Table reads: A score of 81–84 was made by one pupil residing in a small city and by one pupil residing in a city or suburban community.

ciples of conservation, it is clear that the present instruction in this subject-matter area fails to produce results which measure up to desirable standards of accomplishment.

2. Pupils living in rural communities possess more conservation information than do those living in either the small city or the city and suburban community. The degree of difference, however, is less than might be expected. This may indicate that teaching and incidental learning tend to balance the assumed value of more immediate contact with the conditions affecting conservation.

3. Pupils in Missouri high schools have more information about soil conservation than about any other division of conservation considered in this study. It is impossible to determine the exact sources of this information. In addition to the teaching being done in the schools in this division, conservation information is made available through newspapers, magazines, the radio, farm bulletins, demonstrations, speeches, and other sources by governmental organizations, colleges of agriculture, county agents, and similar agencies. These apparently are making an important contribution to conservation education.

4. Subjects such as biology, general agriculture, vocational agriculture, general science, botany, and geography are the most effective in giving information about conservation. However, in view of the rather

TABLE IV

PERCENTAGE OF SUCCESSFUL PERFORMANCE ON THE DIVISIONS OF THE TEST

Division	Freshmen	Sophomores	Juniors	Seniors	Total
Forests	54.3	55.2	58.5	60.2	57.3
Animals	43.6	46.6	46.9	51.8	47.6
Plants Other Than Forests	42.9	46.4	49.4	52.5	48.1
Soils	55.7	60.2	63.4	69.3	62.7
Mean	49.5	52.4	54.6	58.6	54.1

limited enrollment in general agriculture, vocational agriculture, and botany, such subjects as biology, general science, citizenship, and geography, which enroll a larger percentage of the school population, offer the greatest opportunity for future training in this area of the educational program. In addition to these subjects, American history, Missouri history, American problems, economics, sociology, commercial geography, chemistry, industrial arts, and physiography offer possibilities for training in conservation to smaller numbers of pupils.

5. In view of the fact that pupils say that such organizations and activities as the Boy Scouts, Girl Scouts, Camp Fire Girls, 4-H Clubs, Future Farmers of America, conservation clubs, wildlife clubs, nature study clubs, and summer camps have contributed to conservation information, these organizations and activities appear to afford further possibilities in the program of conservation education. More emphasis on the various phases of conservation and a greater degree of pupil participation in the programs of these agencies would be valuable.

6. Pupils in Missouri high schools get information about conservation through newspapers, magazines, the radio, movies, books, farm bulletins, hearing speeches, and the publications of the Missouri Conservation Commission. Efforts to make available through these sources a greater amount of scientifically accurate information on the various phases of conservation are especially desirable.

TABLE V

THE NUMBER AND PER CENT OF PUPILS CHECKING EACH SUBJECT AND ACTIVITY AS HELPFUL, COMPARED WITH THE PER CENT OF THE TOTAL GROUP

Subject and Activity	Number Participating	Per Cent Checking Helpful	Per Cent of Total Group
Biology	791	65.4	28.5
General Agriculture	612	64.4	22.4
Vocational Agriculture	193	60.6	6.9
General Science	1822	57.2	65.5
Summer Camp Work	389	56.8	14.0
Reading Missouri Conservation News Bulletin	271	54.9	9.7
Boy Scouts	602	54.6	21.8
Botany	45	53.3	1.9
Geography	1906	51.4	68.7
Nature Study Club	191	51.3	6.8
Reading Newspapers	2249	49.3	81.0
Reading Magazines	2109	48.0	76.0
Girl Scouts	330	45.7	11.8
Listening to Radio	1892	45.5	68.1
Hearing Speeches	1297	42.1	46.7
American Problems	226	40.7	8.1
Commercial Geography	94	38.2	3.3
4-H Club Work	431	37.8	15.5
Conservation Club Work	60	36.6	2.1
Economics	272	34.5	9.8
Citizenship	1878	33.7	67.6
Zoology	22	31.8	.8
Camp Fire Girls	131	31.2	4.7
Sociology	232	29.7	8.3
Wildlife Club Work	74	29.5	2.3

TABLE VI

OTHER SUBJECTS AND ACTIVITIES LISTED AS HAVING BEEN DEFINITELY HELPFUL IN ANSWERING THE TEST ITEMS

Subjects and Activities	Number Indicating Each
Living in the country	90
Talking with other people	72
Hunting and fishing	57
Reading books	50
American History	43
Movies	39
Chemistry	38
Traveling	37
Reading farm bulletins	16
Industrial arts	15
Physiography	13
Missouri History	10
Physics	7
C.C.C.	7
Visiting farms	7
Future Farmers of America	4
Home Economics	4
Bird study	3
Writing essay on conservation	3
Muir Club	2
Reading game laws	2
Junior Academy of Science	1
Explorer Patrol Group	1
4 Square Club	1
Science Club	1
Hi-Y Club	1
Debates	1
Square Circle	1

NEEDED ADDITIONAL INVESTIGATIONS

1. It would seem desirable to have the problems in this study submitted to further verification. Future investigations might well include members of the junior high school and the elementary school years.

2. Attitudes developed as a result of the teaching of conservation are of vital importance. Investigations to determine the extent to which desirable attitudes are developed by agencies in and out of school should be made.

3. It would be desirable to determine the extent to which known conservation principles are practised in daily life.

4. A successful program in conservation education depends upon the teachers who are responsible for the direction of the program. Studies of teacher preparation for conservation teaching are needed.

5. Experimentation on the development and grade placement of subject-matter is a very essential element in the whole program of conservation education.

6. There are two fields of thought on the problem of introducing conservation into the school program. One point of view is that a separate course in conservation should be introduced. The other favors integration with existing courses. Experimental studies dealing with methods of introducing and organizing the subject-matter are needed.

7. Experimentation designed to discover areas of the program which can be presented effectively through such agencies as newspapers, magazines, the radio and movies seems desirable.

8. A study of the conservation content of textbooks and other teaching materials commonly used in the various school subjects would be valuable in that it would reveal the extent to which conservation is considered in the school subjects now taught. Such a study might also be concerned with the reliability of the subject-matter of conservation found in such textbooks and other teaching materials.

Those charged with the responsibility of directing the educational program of the schools, especially with the problems of effective teaching, realize that there are many areas in which specific and accurate knowledge of how to make instruction function is very limited. There are doubtless many other problems dealing with conservation education, investigation of which would be of material value. These problems were raised either directly or by implication as a result of the present study.

OUT-OF-SCHOOL SCIENCE ACTIVITIES OF JUNIOR HIGH SCHOOL STUDENTS

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During the three years of the Junior High School, students spend much of their school time in Science courses. They are carefully guided through Units of Work with the aid of texts, demonstrations, experiments, reference readings, trips, etc. We may say that for the most part, they are getting a fairly complete and worthwhile introduction to the Sciences. But—what science activities do these children participate in after school is over for the day, or during weekends, or during summer vacations? Is there a linking between Science in school and Science out of school? Do our conscientiously prepared Units give the children the information, skills, and attitudes that will help them in their hobbies, their home duties, their family relationships? What emphases should be placed on the various ideas presented in the Junior High School Science courses to best meet the needs of children in their out-of-school science activities?

We have all heard it said over and over again that Science in our civilization is of ever-increasing importance. What better place is there in which to plant the seeds of a more intelligent appreciation and use of Science in adult life than in our Junior and Senior High Schools! Science can provide the broader viewpoint, the better attitude of mind, the improved way of thinking, and the facts and skills which will make child or adult a more efficient individual. Science can provide for intellectual interests and aesthetic tendencies in the form of leisure time pursuits, hobbies, and avocations. And it is not beyond the range of possibility that these amateur scientific activities can be of definite value to Science and to the country at large. Bird-banding enthusiasts have added much to the knowledge of bird migration—observers of meteors have aided astronomy—amateur fossil hunters have discovered many prehistoric remains. Pursuit of scientific interests in childhood, or later, gives practice in the various phases of the scientific method of thinking, which practice can lead to the use of this method in the solving of individual and group problems in economics, politics, and the like. And Science is a field so broad that nearly all individuals find themselves interested in at least one phase, whether they be young or old, rich or poor, skilled or unskilled, city dwellers or rural residents. Citing but one value from this broadness of interest—Science provides a point of mutual interest which leads easily to a greater understanding between parents and children, between teacher and pupils, between professionals and laymen.

If Science can do all these things (and authorities agree that it can) how important it is that our school Science should be of such calibre that our children will realize its importance to them! Again we ask—Are our Junior High School pupils finding in their Science courses the help they need for active participation in out-of-school Science? Are the courses awakening new interests in Science? Does the child who gets an "A" in Second Year General Science, for instance, put into practice what he has learned about Oxidations when he is called upon to build a fire? And does the child who has become proficient in photography outside of school come to realize fully the application of a Unit on Light Energy to his hobby?

In an effort to learn the answers to these questions, a study is now in progress at the Stewart Junior High School in Salt Lake

OUT-OF-SCHOOL SCIENCE ACTIVITIES

	1	2	3	4	5
Helping to choose household supplies—soaps, canned foods, etc.	59	55	53	7	22
Helping to plan menus for meals	49	44	41	8	24
Helping to plan school lunches	46	37	38	4	14
Helping to choose own clothes	60	55	53	30	34
Helping to care for garden	50	41	19	10	18
Helping to train and care for pets	54	42	34	22	36
Helping to choose toothpaste, mouthwashes, creams, etc. in the home	43	37	38	1	11
Helping to choose medicines	9	6	6	0	7
Helping to fix the family car	20	19	11	5	10
Helping to fix electrical appliances and wiring	19	15	12	5	11
Helping to care for farm animals	20	14	7	9	21
Raising plants for sale	7	4	1	1	7
Raising animals for sale	11	7	2	3	8
Taking animals to Shows (Dog, Cattle, Pigeon, etc.)	11	4	0	2	20
Making mechanical models	18	18	13	8	19
Making deep-sea diving outfits	2	2	1	0	9
Making motor-driven cars	7	4	2	3	16
Experimenting with radio	18	11	8	8	21
Experimenting with chemistry	19	13	6	5	25
Experimenting with the microscope	22	15	9	6	25
Taking pictures	51	45	22	22	39
Taking pictures of nature, especially	23	17	6	4	17
Developing and printing pictures	8	6	3	1	26
Enlarging pictures	3	1	1	0	17
Drawing or painting or modeling scenes, animals, plants, etc.	41	32	23	14	18
Writing stories about science	19	14	3	2	7
Writing articles about science	17	14	7	1	6
Writing poetry about science	10	8	3	1	5
Reading scientific articles and books	43	36	34	1	12
Reading science stories	40	36	35	5	17
Writing music about nature	6	5	2	0	3
Listening to music about nature	26	26	19	2	10
Listening to science programs on the radio	53	47	44	11	28
Going to the movies to see science features and short subjects.	41	38	30	13	23
Talking to authorities in aviation, chemistry, radio, zoology, etc.	19	14	11	6	16
Discussing science topics with the family at home	47	37	34	6	17
Going to lectures on scientific subjects	18	11	7	1	13
Visiting museums	52	37	17	14	33
Visiting bird refuges, zoos, breeding stations	49	41	11	8	28
Visiting airports	56	47	21	13	33
Visiting factories, power stations, radio stations, mines, etc.	41	37	20	8	32
Earning nature badges in scouting	12	9	7	2	18
Collecting fossils	10	8	4	2	15
Collecting minerals and rocks	19	19	8	5	18
Collecting flowers	11	9	2	1	7
Collecting leaves	16	11	1	3	10
Collecting insects	11	7	4	1	8
Collecting pictures and articles on science	12	6	6	0	5
Doing magic tricks with chemicals	14	14	4	4	18
Doing other types of magic	13	13	7	4	13
Taking walks to study birds	18	17	5	0	8
Taking walks to study nature, in general	33	29	10	5	11
Helping to choose camping sites, drinking water, etc., on hikes	47	39	19	12	27

OUT-OF-SCHOOL SCIENCE ACTIVITIES—Continued

	1	2	3	4	5
Taking auto trips to canyons, parks, bird refuges, etc., to study nature	51	47	27	15	42
Observing the stars and planets at night, noticing eclipses, etc.	59	48	55	24	38
Helping to protect wild plants	47	30	7	8	45
Helping to protect wild animals (birds, traps, etc.)	47	37	17	22	53

City, Utah. As a first step, sixty-two pupils in the first year of the Junior High School checked lists of fifty-seven possible Out-of-School Science Activities, indicating their individual participation. These children, it should be said, represent a fairly select group, their families being chiefly in the professional or semi-professional groups, and their intelligence, economic status, and home environment, being somewhat higher than average. Before presenting the tabulation of Activities, a partial list of the 1939 Christmas gifts received by these children (only those having some scientific aspect are included) may be of interest. Some of these gifts were definitely asked for by the children while others were chosen by parents and friends on the basis of the children's previous interests. Only seventeen of the sixty-two reported that they had received nothing "scientific."

3 puppies, 1 fish, 3 turtles
3 cameras, 2 photographic equipment
3 radios, 1 radio equipment
1 microscope, 3 microscope equipment
1 insect-collecting set
1 chemistry set
2 chemical garden sets
1 telescope
11 model airplanes, boats, trains
1 metal casting set
15 books (Birds, Butterflies, Stars, etc.)
4 magazine subscriptions (Popular Science, Aviation, etc.)

In the tabulations which follow, the numbers represent the number of affirmative answers given by these sixty-two children to these questions:

Column 1: Have you ever taken part in this activity?

Column 2: Have you taken part in this activity while you were in the sixth grade and during the past summer vacation, September 1938 to September 1939?

Column 3: Have you taken part in this activity since school began this year, September 1939 to November 1939?

Column 4: Check the activities you have enjoyed most, checking not more than six.

Column 5: Which of these activities would you like to take part in in the future, providing you are given the opportunity?

It is obvious that Column 2 is the least valuable column of the tabulation since it relies so completely on the children's memories of past activities within a specified period. The other four columns, however, do give us a picture of the extent to which these children use Science in their out-of-school lives, whether they recognize it as Science, or not.

It will be noticed immediately that there is a great difference between items in the amount of participation, the amount of enjoyment, and the desire for future participation. And as is to be expected, there is an important difference in the participation of boys and of girls. For instance, most of the checks for items 1 through 4, were given by girls, while most of the checks for such items as "Helping to fix the family car," "Helping to fix electrical appliances and wiring," "Experimenting with radio," were given by boys. There was also a great difference in Science Interest noted between individuals, some children checking the majority of items listed, others checking very few.

These mimeographed lists of Activities have also been checked by second and third

year students, with observable differences in participation due to the additional year or two of age. The results, however, from all three groups of students are similar: namely, that this group of Junior High School students takes part to a rather astonishing degree, out of school and away from Science courses, in activities which have a definite Science content.

The second step in this study will be this: to determine as definitely as possible, the extent to which the seven or eight Units included in each of the three years of Science as given in this particular Junior High School provide for increased and more efficient participation in the Out-of-School Science Activities listed above. Or in other words, we are trying to find out exactly how functional our present Science program really is.

THE DEVELOPMENT OF GENERALIZED SCIENCE COURSES IN STATE TEACHERS COLLEGES *

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THE PROBLEM

The problem of this investigation is to make a study of the development and present status of the teaching of generalized science courses in the state teachers colleges. Two-year normal schools or teacher training departments of state universities are not included.

The term "generalized science" as used in this study includes any course intended for college students which draws its subject matter from two or more of the different science divisions such as astronomy, chemistry, physics, and so forth.

Some of the more commonly used terms referring to generalized science courses are "orientation courses," "introductory courses," "general science courses," and "survey courses."

SOURCES OF DATA

The principal source of data for this investigation was the returns of the questionnaire sent by the writer to the state teachers colleges. In addition, information was secured from the catalogs of those teachers colleges that did not reply to the questionnaire, from generalized science textbooks, and from syllabi used in connection with these courses. Research investigations and other periodical literature were used to a considerable extent. Personal correspondence was resorted to for information which could not be gained by methods previously stated.

METHOD OF PROCEDURE

The questionnaire was used in securing the principal portion of the data for this study. The writer realizes that there are many weaknesses in the questionnaire technique as a means of research. However, valuable information can be gained by this method which could not be secured by any other practical means.

In preparing the questionnaire, much care was exercised by the writer in eliminating, as far as possible, all questions which would necessitate subjective responses. Approximations were called for instead of exact quantitative measures where approximations would be the logical response.

An attempt was made to formulate a questionnaire which could be answered readily but not at the price of sacrificing accuracy. This form could be filled in easily in five minutes.

These questionnaires were sent to the

* An abstract of a doctoral dissertation, George Peabody College for Teachers, 1938.

head of the Department of Science of all the state teachers colleges. The returns were analyzed carefully. The results of this analysis are given in the Summary of Findings.

Research investigations and other periodical literature were studied carefully for the purpose of gaining information concerning the general trends and historical development of generalized science courses.

Four of the most frequently used textbooks, several syllabi, and three of the more recent textbooks which were not published at the time the questionnaires were returned were analyzed for additional information concerning the content of generalized science.

A study was made of the catalogs of those colleges which did not reply to the questionnaire for information concerning the scope of this general movement. Personal letters were written to some influential men in the field of science education for the purpose of securing data which otherwise were not available.

SUMMARY OF FINDINGS

Bossard [1] says that the first orientation course to be offered in American colleges was that at Brown University in 1915–1916. The first course of the survey type to receive wide recognition, however, was that which was formulated in the University of Chicago in 1923–1924. This course was organized by H. H. Newman [2] who, with some of the other members of the faculty of the University of Chicago, wrote the first textbook for courses in generalized science, entitled *The Nature of the World and of Man.*

Generalized science has had an extensive period of development within the last ten years (1928–1938). This movement seems to be gaining momentum with increasing acceleration. At first, single courses were organized. At the present time, however, there seems to be a general trend to offer complete patterns of these courses. The college curricula of many institutions have undergone a complete revision for the purpose of giving a general education program. This general movement has spread from single institutions to entire state systems.

Havighurst [3] (1935) reports that a study made in 1926 of the curricula of 300 colleges indicates that five were giving survey science. A similar study [3] made in 1934 indicates that out of approximately 1,400 institutions of higher education, 150 offered courses in generalized science, approximately 50 of which were teachers colleges. Since there are 88 teachers colleges offering such courses at the present time (1938), there is an apparent increase of 38 colleges, or 76 per cent, for the four-year period 1934–1938.

An examination of the geographical distribution of teachers colleges offering generalized science shows it to be widely distributed throughout the United States. No state or group of states appears to be predominant in this science offering in relation to the number of state teachers colleges.

In every state which has state teachers colleges, survey science is offered in one or more schools. The accrediting agencies of higher institutions do not seem to have a marked influence upon the curricula as far as generalized science is concerned. The North Central Association is the regional accrediting agency for twenty states. Of the sixty-three state teachers colleges in these states, thirty-six schools, or 57 per cent, offer such courses. The percentage is somewhat higher for the other associations. Each of these other associations, however, represents a smaller number of teachers colleges.

The student population which is affected

[1] Bossard, James H. S. *Man and His World.* New York: Harper and Brothers, 1932.

[2] Newman, H. H. "An Orientation Course." *Journal of Higher Education,* 2: 121–126; 1931.

[3] Havighurst, Robert J. "Survey Courses in the Natural Sciences." *The American Physics Teacher,* 3: 97–101; 1935.

by these courses is also a significant factor. The total enrollment in survey science for 64 schools was shown by the questionnaire returns to be 8,542. The number taking these courses varies from 6 in one college to 671 in another.

In a large number of the teachers colleges generalized science courses are required. Of the sixty-eight schools giving information concerning this topic, fifty-three, or 78 per cent, report that these courses are required under some conditions.

Generalized science courses probably introduce the student to a greater variety of scientific material than any other course of equal length in specific science subjects. Instead of being confined to certain equipment pertaining to a definite subject matter, as in the case of physics, chemistry, or biology, the survey course includes laboratory exercises or demonstrations involving the use of equipment of many of these specific sciences as well as many other types of material not found in technical science laboratories. The number of schools supplementing this science course with such things as rocks, minerals, fossils, pictures, industrial specimens, object material, and plant and animal collections indicates that instructors of generalized science are interested in making connections between the science taught in the classroom and the student's environment.

Following the general trend of the influx of generalized science courses into the colleges, numerous textbooks of physical science have been designed especially for these courses. The apparent lack of a wholly satisfactory text is emphasized by the widely scattered selection of different textbooks. There seems to be a very decided tendency, however, to use a basic text in these courses.

An analysis of four of the most frequently used textbooks in generalized science and three of the most recent ones published in this field shows a wide variation in the subject matter offered. Of the twenty-eight major topics found in one or more of the seven books analyzed, only six were common to all. These topics are: Theoretical Chemistry, Solar System, Magnetism and Electricity, Lighting and Photography, Stars, and Weather and Climate. These may become a nucleus around which a general science text, with a definite subject matter, will be formed that will meet the general approval of science teachers.

Many schools seem to use general biology text, rather than strictly survey texts, in connection with survey courses in biology. Only one survey text in this field has received much recognition.

Some colleges supplement the basic text by using a syllabus while others use the syllabus in place of the text.

The general nature of the topics listed in the syllabi indicates that many science instructors are selecting certain units of subject matter from the specific sciences and presenting them for introductory rather than cultural purposes. This seems more apparent in the case of biological science syllabi.

Thirty-two different titles have been used by the teachers colleges in referring to generalized science courses. Of this number, 34 per cent of the colleges use either "general science" or "physical science" as the title.

Some of the courses of generalized science are presented under titles of the older specific science headings. The majority of the titles, however, are of a more general nature. From the various course titles and stated objectives of generalized science, it is apparent that the greatest concern is the development of a course whose subject matter is composed of the principles and applications of both the older specific sciences and of current science, and which is presented in such a way as to help the student meet the conditions of his environment more efficiently.

Generalized science courses have become

well established at the freshman and sophomore college level. Some few colleges, however, do offer such courses in the senior year. It is significant to note that 62 per cent of the courses reported contain no seniors. There is also an absence of juniors indicated in 52 per cent. Only three courses show enrollment of juniors or seniors in excess of 50 per cent. The general practice seems to be that of giving generalized science as required courses only for freshmen and sophomores. This probably accounts for a large part of the enrollment at that level.

The data showing the approximate proportion of the courses devoted to different specialized areas of subject matter seem to indicate two major types of generalized science courses. One of these comprises subject matter, in the main, from four specialized science fields: physics, chemistry, astronomy, and geology, with physics predominating, while the other is devoted primarily to the biological phase. Psychology seems to have been given little consideration in connection with the survey courses, for only thirteen of the sixty-five schools reporting mentioned the subject.

The task of deciding upon the method to be used in presenting these science courses seems to be as difficult as that of choosing the subject matter. The favorite types used are the lecture and lecture-demonstration methods. Only 41 per cent of the schools replying give individual laboratory training. The diversity of subject matter and large enrollments tend to favor the lecture and lecture-demonstration techniques.

There is a wide variation in the maximum amount of credit allowed for generalized science among the different colleges. The total credit allowed by schools reporting in terms of semester hours varies from one to twelve with the mode at three. For those schools functioning on the quarter basis, the variation is from two to twenty with the median at six.

The kind of testing used for generalized science courses probably varies with the class size and the method of instruction. A combination of teacher-made objective and essay are used most frequently. Twenty-four of the schools reporting use objective type tests exclusively, while two give only the essay type.

There is a decided tendency to give these tests at frequent intervals. Of the sixty-six schools giving information concerning this topic, 32 per cent give tests every two weeks or oftener. Forty-one in number, or 62 per cent, give tests as often as once a month. Many schools give tests at mid-term and end of course in addition to those given at definite intervals throughout the term.

The question, "Who is to teach?" became a grave issue at the very inception of generalized science courses in the college curriculum. Newman, at Chicago in 1923–1924, attempted to answer it by drafting the services of specialists in specific fields such as physics, chemistry, astronomy, or geology. These instructors were called in to conduct that part of the course pertaining to their own subject matter fields. After several years of experimentation the usual plan utilized by the teachers colleges is to have one instructor remain with the class throughout the course.

Of the sixty-nine schools reporting, 75 per cent report that one instructor teaches the class throughout the entire course, while 25 per cent change teachers for the different subject matter divisions.

There is a wide variation in the professional training of those who are teaching generalized science in the teachers colleges. While the chemistry and physics teachers are bearing the greater part of the burden of generalized science, the teachers of biology and other sciences are also contributing to this broad science field. Of the fifty-six different combinations given, in regard to the professional training of these generalized science instructors, that

of chemistry major with physics minor ranks first in frequency, with the physics and mathematics combination coming second. Chemistry and physics appear in combination with other subjects or alone, as either a major or minor, with almost equal frequency.

Of the one hundred thirty-three instructors whose professional combinations are given, 41 per cent have a major or minor in chemistry, 39 per cent have a major or minor in physics, while 23 per cent have either a major or minor in biology.

These instructors usually devote from three to four hours a week to the generalized science program.

Although these courses usually are offered at the freshman or sophomore levels, 46 per cent of the instructors reported held the doctor's degree.

The six subjects which appear most frequently, either singly or in combination with other subjects, as forming part of the teaching load of these generalized science instructors rank, according to frequency, as follows: physics, chemistry, biology, botany, zoology, and geology.

From the data of this investigation, it seems apparent that generalized science is serving a unique and distinctive purpose in the teachers colleges.

AN EVALUATION OF THE PRINCIPLES OF CHEMISTRY AS SHOWN BY ADULT ACTIVITIES *

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PROBLEM

Many attempts have been made to revise our curriculum in terms of the needs of individuals. Educational leaders have long recognized the need of such procedures in planning curriculum changes. The soundness of previous methods in determining activities and needs of adults is in some cases questionable. The dynamic character of our civilization will permit no curriculum to remain unchanged for a long period of time.

In the past speculative philosophy has determined the trend of curriculum construction. The philosopher has in most cases ignored the field of practical life and the curriculum has become inapplicable to life situations. The result of this has been a sweeping indictment of all educational procedures and a concerted demand for curriculum revision.

The philosophy of education is entirely sound and need not be set aside in order to permit changes. Both philosophic and dynamic phases must be considered before the curriculum is altered. Life situations can be used as a guide in organizing and arranging scientific principles and fitting them to human needs. If the individual is to be trained for participation in human experiences then his needs become the criterion for curriculum construction. Harap [1] states the method as follows:

> The plan to be employed is activity analysis. The first step is to analyse the broad field of human experience into the major fields. The lines can be drawn in any number of ways. Each curriculum making group will make the divisions that seem best to it for its purposes.

Since there is an absence of information in the field of human activities it seemed the logical area for investigation. The diary as a tool for curriculum research has been used by Cunningham [2] to determine

* Abstract of a Master's Thesis, Colorado State College of Education, 1937.

[1] Harap, Henry. *The Technique of Curriculum Making,* p. 8. New York: The Macmillan Company, 1928.

[2] Cunningham, H. A. "Activities of Science Teachers." *Science Education* 14:304; November, 1929.

activities of science teachers. After comparison with other methods of determining activity, it was found to be defensible.

METHOD

The purpose of this study was to use the diary as a means of obtaining the raw data as the diary presented the activity of the individual. Sixty-two people out of a hundred agreed to keep diaries. The data represented three weeks of life experiences of sixty-two people during fall, winter and spring. It covered a sampling of the general population with no attempt at an industrial spread. The group included engineers, preachers, teachers, farmers, clerks, auditors, printers, postmen, housewives and others. The element of suggestion was not present as the contributors did not know what subject matter was to be examined.

The principles of chemistry were selected from a list compiled by previous investigators [3] evaluated by suitable criteria and accepted by competent educators. The criteria has been formulated by Robertson [4] and were used by a competent jury in selecting the principles.

The diaries were collected, analysed into the various activities recorded during the day and tabulated on a frequency table. The list was then revised under twelve major headings as commuting, activities for entertainment, activities pertaining to fuel, home activities, working for pay and others. A total of one hundred and eighty-three activities made up the list. The frequency of performance varied from 1,162 records of eating at home to 4 for watering of animals.

The activities having chemical significance were selected and delimited by a criterion, namely, would the understanding of the chemical principle make the performance of the activity more effective. The allocation of chemical principles to the activity was made upon the basis that the activity implied chemical significance and that the knowledge of the principle would have utility value in the performance of the activity.

The selection of the activities having chemical significance was checked and approved by a jury of three.[5] This same jury also served in determining the activities in which the principle was found to ramify.

The rank value of each principle was then determined by the frequency with which it occurred in the activities listed by the contributor.

CONCLUSIONS

This study indicates that certain principles of chemistry are more important than others when adult activities were analysed. Principle five, "the rates of chemical changes are determined by the nature of the interacting substances and the conditions of concentration, catalysis, temperature, pressure, state of division, amount of radiation absorbed and the nature of the solvent," had the highest rank with a frequency of 2,354. Principle seven and seventeen followed in order of importance. The principles having highest rank were those concerned with food marketing, preparation, and consumption.

Daily life activities involve few situations where an understanding of the principles of chemistry pertaining to electrolytes, the gas laws, the law of multiple proportions, radio activity or energy constants are applicable. The principles having the lowest ranking are not necessarily those of least importance, but are those having least utility value when based upon an activity list.

[3] James, Edward W. *The Principles of Chemistry for Secondary Science Instructors.* Unpublished Master of Arts Thesis, Colorado State College of Education, Greeley, Colorado, 1935.

[4] Robertson, Martin L. *A Basis for the Selection of Content in Elementary Science Instruction.* Unpublished Doctor's Dissertation, University of Michigan, 1933.

[5] The jury consisted of Miss Edith Selberg, M.A., Mr. Darrell Barnard, M.A., and Mr. Lon Edwards, M.A., of Colorado State College of Education, Greeley, Colorado.

THE ELIMINATION OF SUPERSTITION IN JUNIOR HIGH SCHOOL SCIENCE *

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Some superstitions are as old as man, while others are as modern as the radio. Most of them are products of the social heritage, but many are constantly springing up from the fertile soil of human nature in a changing environment.

New misconceptions are fast becoming superstitions through the wide-spread influence of the radio, newspapers, cheap magazines, and the movies. Advertising campaigns are building up a mass of credulity by means of suggestion and the insidious art of playing on the more common fears.

It is impossible to disregard the evidence demonstrating the pernicious influence of superstition on the behavior of people in both the past and present. The first point under consideration is that boys and girls of today are growing up in a world that is becoming highly mechanized due to the great progress which has been made in the field of applied science. With this situation in mind it can readily be inferred that archaic beliefs and patterns of behavior must be altered to fit the existing conditions. Many should be entirely eliminated. In the second place, genuine scientists as a rule are not zealous about the presentation of their findings to the populace; while on all sides pseudo-scientists and quacks of all descriptions are using the banner of science to further their own ends at the expense of those who have not had sufficient training to enable them to distinguish between the genuine and false. The third point is that uncritical acceptance of such beliefs breed behavior patterns which result in a waste of time and money, and unsatisfactory mental and physical health. Finally, this short-sighted acceptance of beliefs based upon insufficient facts may prove detrimental to society and democratic government.

In surprising contrast with the definite need for carefully directed educational work in the field of superstitions is the vague uncertainty as to the best methods for reducing the number of false beliefs that are influential in directing behavior. Only in recent years has there been a conscious effort made to eliminate superstitious beliefs at the source of their inculcation, in childhood. There is no question that one of the most vulnerable points in making an attack on superstitious beliefs is through the pupils studying general science.

THE PROBLEM

The main problem of this study was to discover the amount of elimination of superstitious beliefs of pupils taking general science after a unit of work dealing with superstitious beliefs has been given. Three minor phases will be taken into consideration; namely, a survey of the most commonly heard, believed, and influential superstitions, the comparative difficulty of elimination of different types of superstitious beliefs, and finally, a collection of local superstitions and misconceptions which seem to be native to the community in which the study was made.

THE PURPOSE OF THE STUDY

The ends sought in this investigation are as follows: (1) a survey of the most commonly heard, believed, and influential superstitions, (2) the comparative difficulty of elimination of different types of superstitious beliefs, (3) a collection of local superstitions and misconceptions which seem to be native to the community

* Based on a Master's Thesis, University of Michigan, 1938.

in which the study was made, (4) the development of a teaching unit pertaining to superstitious beliefs, (5) the building of a hundred item true-false test using the fifty most common superstitions found in the preliminary survey test interspersed with fifty items of common scientific knowledge.

METHOD OF RESEARCH

Four general science classes of the Central School at Iron River, Michigan were used in the study. One hundred and thirty-five pupils, seventy-four boys and sixty-one girls were given the pre-test. One hundred and twenty-eight pupils, seventy boys and fifty-eight girls were given the final test. The following procedure was used:

1. A pre-test of 198 superstitions compiled by Caldwell and Lundeen was given in September, 1937. In this test the pupils checked the following points: "heard," "belief," and "influence." After the test was given the fifty most commonly heard, believed and influential superstitions and misconceptions were extracted.

2. "How Knowledge Grows," a teaching unit pertaining to scientific thinking and superstitious beliefs, was introduced. The time allotment was six weeks. The objectives set up were the following: (a) Teacher's objectives: first, to eliminate superstitions and misconceptions in science; second, to develop a critical attitude regarding unfounded beliefs; (b) Pupil's objective: to acquire the ability to distinguish between facts and superstitions or misconceptions.

3. During the first week of school each class was divided into five groups with about six members in each group. The pupils grouped themselves, the only regulation being that each group was not to have more than four of either sex. Each group elected a leader for the duration of the unit. This leader acted as an intermediary between the group and teacher and also was responsible for the activity of the group. The teacher met with the leaders of each class at least once a week for general consultation and conference. For specific group activities, leaders were given a written outline of major points.

Each group collected and performed experiments with various superstitions and misconceptions, and formed discussion groups that had charge of the daily classroom program. The superstitions and misconceptions collected by the various groups were classified. From the resultant list, each group selected a few to demonstrate experimentally before the class. The privilege of unlimited interrogation on the topic under experimentation or discussion was given to the rest of the members outside of the group in charge.

Out of the group activities and discussions various divisions of work were evolved. For example, a number of superstitions were used as a basis for classroom experimentation and observation. Each experiment was planned and demonstrated by a definite group of pupils. The teacher conferred and discussed with each leader on the various phases of the experiment. A discussion was held among the members of the group as to the best methods of performing the experiment. This naturally led to specific delegation of responsibility. A few typical group officials were the announcer, collector of equipment, experimenters, and recorder. When the activity was completed and ready for presentation, all the pupils had contributed to its fulfillment in accordance with their relative abilities.

As a form of group motivation, leaders of the various groups alternated, weekly, in keeping a graphical record on the blackboard of the progress of the various groups in collecting false beliefs.

Committees composed of the leaders of various groups made master copies of the superstitions collected by each class and the total group. The five leaders of the groups

in each class made a master copy. The final copy, a composite of the four classes, and a Professor Quiz program given before the P.T.A., was worked out by a committee of four of the ablest leaders with the teacher.

Each class period of one hour was generally divided into one-half hour for study, reference reading, individual and group consultation; the second half hour for group experiments, discussions, quiz programs, etc.

The following is a list of activities employed by the groups: (1) A list of local superstitions and misconceptions were collected by direct questioning of members from approximately 135 homes. (2) Superstitions, misconceptions, and advertising slogans found in newspapers, magazines, and radio were collected in relation to their respective heads. (3) Each group analyzed and classified their collection under various headings and in relationship to nationalities, occupations and types. For example, two false beliefs such as: "A four-leafed clover placed in the left shoe will help in getting a ride when hitch hiking," or, "Frogs freeze up three times before spring comes," would be carefully scrutinized for the element of luck, charm, or the supernatural. (4) Fourteen simple experiments like walking under a ladder brings bad luck, picking up a toad produces warts, breaking a mirror brings bad luck, staring at a person's back will make him turn around, etc., were experimentally demonstrated by different groups. (5) Group discussions on the causal relationship of the elements of various types of superstitious beliefs were held. (6) A series of true-false radio quiz programs was held in the classroom and on general assembly programs. The final program was held during the P.T.A. meeting with parents as subjects. (7) The final results were tabulated, and a generalized summary and discussion of the unit on superstitious beliefs was held in each classroom.

TABLE X

A COMPARISON OF THE NUMBER AND PER CENT OF PUPILS TAKING THE PRE-TEST AND FINAL TEST

Section	Pre-test						Final Test					
	Boys		Girls		Total		Boys		Girls		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
I	15	45.5	18	54.5	33	24.5	13	43.4	17	56.7	30	23.4
II	26	81.2	6	18.8	32	23.7	25	86.2	4	13.8	29	22.7
III	16	45.7	19	54.3	35	25.9	15	44.1	19	55.9	34	26.6
IV	17	48.6	18	51.4	35	25.9	17	48.6	18	51.4	35	27.3
Total	74	54.8	61	45.2	135	100.0	70	54.7	58	45.3	128	100.0

4. The final test was given in January more than two months after the teaching project. It was considered by the pupils as a semester examination. The test was composed of 100 items. In this test the pupils checked "Yes" or "No" under the following points: believe and influence. Fifty of the items were the most commonly believed superstitions and misconceptions found in the pre-test; the other fifty were general scientific truths mixed in chance order.

THE SPECIFIC RESULTS

The number and per cent of pupils taking the final test in comparison with the pre-test is given in Table X.

It will be noted that seven more took the initial test than took the final, the losses being fairly evenly distributed between the boys and girls throughout the several sections.

The mean loss and the per cent loss is given in Table XII. The per cent loss is calculated from the difference of the means of the pre-test and final test divided by the total number of superstitious beliefs of the final test. Caldwell and Lundeen [1] use a similar procedure of calculation.

There was a mean loss of 10.7 superstitious beliefs per pupil for both boys and girls from the average of 21.7 out of 50 previously held. The per cent of loss for both sexes together was 21.4 per cent.

A comparison of the amount of elimination of the "influencing" effect of these superstitious beliefs is shown in Table XIII.

[1] O. W. Caldwell and G. E. Lundeen. *An Experimental Study of Superstitions and Other Unfounded Beliefs*, p. 110. New York: Bureau of Publications, Teachers College, Columbia University, 1932.

The mean loss per pupil was 6.4 superstitious beliefs. A comparison with the loss in belief (Table XII) shows that there is a greater mean per cent of elimination of belief and less amount of loss for the influencing effect.

The fifty superstitious beliefs were classified under six types of ideas with which the superstitions deal as listed in Column I of Table XV. The responses of the pupils, before and after the direct teaching was given, are compared and the mean loss and mean per cent of loss calculated.

Misconceptions about health seem difficult to eliminate. Pupils believe in many weather proverbs, but eliminate them very readily. The pupils apparently did not believe a great deal in mental telepathy and magnetism. Most of the students were too young to have heard and become interested because of the abstract nature of the problems.

TABLE XII

THE MEAN AND PER CENT LOSS OF SUPERSTITIOUS "BELIEVE" ANSWERS

Section		Pre-test 50 Items			Final Test		Loss	
		No. of Cases	Possible Score	Mean	No. of Cases	Mean	Mean	Per Cent
I	Boys	15	50	20.7	13	8.7	12.0	24.1
	Girls	18		18.7	17	9.3	9.4	18.9
II	Boys	26	50	22.0	25	11.3	10.6	21.3
	Girls	6		22.9	4	11.3	11.6	23.2
III	Boys	16	50	23.6	15	14.1	9.6	19.1
	Girls	19		23.7	19	11.7	12.0	24.0
IV	Boys	17	50	18.7	17	9.0	9.7	19.3
	Girls	18		23.8	18	12.4	11.3	22.7
Total	Boys	74	50	21.3	70	10.9	10.5	20.9
	Girls	61		22.2	58	11.2	11.0	21.9
	Both	135	50	21.7	128	11.1	10.7	21.4

THE GENERAL RESULTS

It was noticed that when pupils in the science classes were able to observe or test

out the superstitions of smaller children or adults, they became extremely interested and critical possibly due to a feeling of superiority. One group experimented on younger pupils by placing a ladder near the entrance of the playgrounds so that the pupils had to go out of their way to avoid walking under it. The number of avoidance reactions were recorded. Another group planned and put on a radio "quiz" program for a P.T.A. meeting. The adult members of the organization were called up and questioned. The result was that all members were eliminated before the one hundred items were used up. As a consequence, at the end of the meeting a great deal of discussion was created between pupils and participants as to the truth or falsity of the items they missed.

That there was developed an attitude of awareness toward various types of superstitions and misconceptions by this direct teaching unit seems to be definitely established. Many questions were asked by the pupils about the truth or falsity of different ideas in connection with other units of study in the classroom and situations arising on scout hikes, at Saturday basket ball games, and during casual conversations with pupils. Perhaps a few of these observations and remarks made by the pupils during the year may lend support to the above statement.

1. Casual Conversation—One boy discovered that his mother was very superstitious. He stated that all his efforts to convince her were of no avail, so he said, "Me and my dad know that superstitions are all the bunk, so we kind of humor her along."

2. Classroom—A unit dealing with health of the human body was being studied. A girl who had not been present at the beginning of the year asked whether toads produced warts. Immediately there were vociferous remarks in the negative declaring in effect that they had handled toads, and they had not discovered any warts on their hands. At this point, some of the pupils near by waved their wart free hands in her face.

3. Classroom—The question was asked

TABLE XIII

THE MEAN AND PER CENT LOSS OF SUPERSTITIOUS "INFLUENCE" ANSWERS

Section		Pre-test 50 Items			Final Test		Loss	
		No. of Cases	Possible Score	Mean	No. of Cases	Mean	Mean	Per Cent
I	Boys	15	50	16.5	15	14.2	2.3	4.6
	Girls	18		15.6	17	7.9	7.7	15.5
II	Boys	26	50	20.9	25	15.3	5.6	11.1
	Girls	6		14.3	4	8.5	5.8	11.7
III	Boys	16	50	21.5	15	13.7	7.8	15.5
	Girls	19		20.3	19	11.7	8.6	17.2
IV	Boys	17	50	14.4	17	11.2	3.2	6.5
	Girls	18		22.6	18	13.3	9.3	18.7
Total	Boys	74	50	18.6	70	13.8	4.9	9.8
	Girls	61		19.0	58	10.8	8.2	16.3
	Both	135	50	18.8	128	12.4	6.4	12.7

during a unit on weather, whether a red sunset is a sign that the following day will be clear. This question was immediately labeled as a misconception by the rest of the class.

4. Scout hike—A boy asked with a grin whether spitting on an angle worm increased the number of fish caught. Another boy who did not see the broad grin answered contemptuously, "Ah-h! That's a superstition."

Many other questions and comments during the year indicated that the unit on superstitious beliefs still had influence on the discrimination of pupils between superstition and facts.

TABLE XV *

THE MEAN PER CENT OF ELIMINATION OF SUPERSTITIOUS BELIEFS IN RELATION TO DIFFERENT TYPES OF IDEAS

Type of Idea	No.	Pre-test	Final Test	Mean Loss	Mean Per Cent Loss
		Total	Total	Total	Total
		Mean	Mean	Mean	%
I. Weather Proverbs	16	7.7	4.1	3.6	22.6
II. Misconceptions, Character Judging, Fortune Telling	12	4.3	1.8	2.5	21.1
III. Signs of Luck, Visitors, etc.	7	2.4	1.0	1.4	20.4
IV. Misconceptions of Health	7	3.3	2.2	1.2	16.6
V. Misconceptions of Natural Phenomenon	6	3.3	1.7	1.6	27.2
VI. Mental Telepathy or Magnetism	2	0.6	0.3	0.3	15.5

* The separate means of Boys and Girls are omitted.

A SUMMARY OF CONCLUSIONS

The results of the factual findings point toward a few generalized conclusions. The following points are conservative generalizations from the numerical data:

1. The pupils "heard" a surprisingly small number of superstitions listed on the preliminary test.

2. The girls in junior high school classes have heard, believe, and are influenced by slightly more superstitious beliefs than boys.

3. The home is one of the great sources for the propagation of superstitions and misconceptions. Magazines, newspapers, and the radio are the great sources for developing slogan thinking. The movies do contain superstitions and misconceptions but not in a very concentrated form.

4. Girls lose a slightly larger per cent of these false beliefs than boys after direct teaching is given.

5. Boys for some reason or other are influenced by a slightly greater number of superstitious beliefs than girls.

6. Superstitions and misconceptions about the weather are heard, believed, and are influential, but with direct teaching are readily removed.

7. The most difficult false beliefs to remove are those about health and mental telepathy. These unfounded beliefs are

deeply-rooted because of the influence of religion, and their intimate relationships with the fundamental needs and wants, such as self-preservation and a life after death.

8. A teaching unit about superstitious beliefs does help in enabling the pupil to become acquainted with a wide range of false beliefs and make it possible for him to discriminate between real science facts and superstitions.

9. The study has shown that a conscious critical attitude toward various types of superstitious beliefs was built up. By means of scientific research, on the part of the pupils, a spirit of uncertainty and a more truthful concept of reality was formed. Therefore, one of the means that general science instruction may use to eliminate superstition is the directed teaching of a general science unit which specifically aims towards eliminating such false beliefs.

INTRODUCING DETAILED INDUSTRIAL CHEMISTRY COURSES IN THE COLLEGE CURRICULUM: PAINTS, VARNISHES, AND LACQUERS *

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HISTORICAL-EDUCATIONAL BACKGROUND

The writer is concerned with those who should be the Platonic "guardians" of our modern civilization; he will direct his time, interest and thought upon the men whom Plato, Bellamy, More and other utopian writers considered should be the creative forces in the social system. He will consider the college graduates, specifically the Bachelors of Science, majors in chemistry, whose twice-yearly exodus from college plunges them, a supposedly superior social group, into the larger categories of the unfortunate—the unemployed. The fanciful vista, the idyllic visions treated in the Utopias enter into this paper only in the aspiring realization by the writer of the significance of the college graduate to progressive society, and the sorrow of their inability to attain constructive employment. Part of the fault for the plight of the chemistry majors, the writer believes, rests upon the present exclusion of detailed industrial courses from the science curricula. This estimate he has not presumed; for in support of this thesis he will analyse pertinent data, factual information which, interpreted, points to the real opportunities for chemistry majors in specific industrial pursuits. He will point out a number of industries—paint, chemicals, soap, *etc.*—which require trained men; industries presenting opportunities to students trained in their purposes.

Among many causes for economic discord, one of great concern to educators is the inadequacy of present training methods which fail to bridge a course to concrete industrial uses, and in this defection contributing to the inability of the student to attach successfully theoretical techniques to his chosen profession. This inability may rise from a lack of native capacity or acquired training, making untenable the practical application of whatever theory has been acquired; or it may follow from the incompatability of the profession to the aptitudes, attitudes and personality of the student. A few years ago, during our era of prosperity, employers were able to assume the responsibility of training graduates for their particular industry, but today he is unwilling to do so due to the existence of a surplus of trained men from whom he

* Based upon a Master's Thesis completed at The City College of New York, 1939.

can draw those of advanced skill without financial cost to himself. Therefore it devolves upon the school, in justice to its students, to solve the problem created by this situation.

THE ROLE OF CHEMISTRY IN INDUSTRY

Chemistry has, since its genesis, contributed greatly to the development of many industries which in time became allied to it. Of these chemical and allied industries in America, only those which report their earnings publicly, had combined profits in 1935, that were exceeded only by those of the automobile industry, according to the New York Times of January 27, 1937, page 31.

"Through the joint efforts of the research chemists and engineers, substantial reductions in production costs have been realized in the manufacture of many chemical products, resulting in correspondingly lower costs to industry and in turn to the ultimate consumer. . . . Through research, chemistry has created new industries giving employment to thousands of workers by developing new uses for old materials. . . . Through many years of research chemistry has made this country independent of foreign sources of supply for such essential materials as dyestuffs, nitrate, fertilizers, camphor and rubber, either by synthesizing naturally occurring materials or by creating a wholly new product."—New York Times, February 17, 1937, page 38.

Here are a few representative industries as listed in the table of contents of *Chemistry and Industry,* edited by H. E. Howe and published by the Chemical Foundation, in which chemistry plays a major role: abrasives, alcohol and other solvents, coke and its products, cotton and cotton products, the electrical industry, electrochemistry, the fertilizer industries, industrial gases, glass, iron and steel manufacturing, leather making, non-ferrous metallurgy, packing house processes, pulp and paper industries, perfumes and flavors, the petroleum industry, photography, synthetic resins, rubber industry, textile industry, aviation, casein utilization, confectionary industry, earthenware and porcelain, electric batteries, electroplating and electroforming, military and industrial explosives, glue and gelatins, inks, lubricants, matches, paints, varnishes, lacquers and colors, Portland cement, radio and incandescent lamps, railroads, rayon, refrigeration, rust-resisting metals, soap, water supplies.

ADVANTAGES OF SPECIALIZED INDUSTRIAL CHEMISTRY COURSES

A specialized industrial chemistry course is a means of training for the student intended to familiarize him with a detailed phase of a chemical industry, e.g., paints, varnishes and lacquers, rayons, liquors, etc. Such a course would necessitate the introduction of miniature equipment of the particular industry into the laboratory. This would enable the student to project into actual industrial application in the laboratory, the theoretical training he gained, and to acquaint himself at first-hand, with the problems involved in the manufacture of an industrial product. It can be seen, that for some industries, complete refitting of a chemical laboratory would be required, the cost perhaps running into thousands of dollars, while for others, very little change and little money would be needed.

SELECTING THE INDUSTRIAL CHEMISTRY COURSE

The selection of industries that need to be taken into account in forming the chemistry curriculum would depend upon five factors: one, the state of development, the stability and future possibilities of a particular industry; two, the importance of the industry to society; three, the demand for skilled men in the industry; four, the cost of re-equipping or furnishing a new laboratory for the course; five, the difficulty of teaching the subject.

The First Factor Considered: The State

of Development, The Stability and Future Possibilities of a Particular Industry.—There are some questions that pose themselves in the study of this factor. How long a period has the industry been in existence? Has the industry developed scientifically during this period? To what extent have methods of production changed since the inception of the industry? Is the duration of time the industry has existed an accurate criterion of the industry's importance?

An industry that has been in existence for a great length of time is definitely established on a solid foundation and the social demands for its products have clearly been determined and assured. However, a scholarly admission is necessary. There are industries in which growth has been of a "mushroom variety" and which have, despite their youth, established themselves in society in a short period. The rayon industry may well be cited as an example. These "mushroom variety" industries usually originate and progress upon the discoveries of new chemical processes; for example, the viscose process for producing rayons. Of course, these manufacturing processes do not remain constant, and because of this, tend to nullify any great probability of continuance. Apparently it would be true that an industry which has existed for hundreds of years and has served the public adequately has a great probability of surviving. On the other hand, an industry whose growth has been rapid, may or may not continue; moreover, no definite conclusion can be reached as to its future status, which is indeterminate. In view of this, a selection based alone upon the duration of time an industry has existed would be a poor criterion in selecting an industrial course; but in combination with the other four factors, a more comprehensive comparison and choice would be possible.

The use of paints, varnishes and lacquers has been traced back to primitive man who used them first, as a protective coating to the body and then in the decorative painting on the walls of his cave. The decorative and utilitarian functions of paints were well understood by the Egyptians, Greeks and Romans. Modern civilization has furnished new uses for these materials and the industry has grown steadily.

The Second Factor Considered: The Importance of the Industry to Society.—A detailed examination of the latest Census of Manufacturers reports, published by the United States Government Printing Office, reveals that the paint industry in recent years has risen to a point of such eminence that one cannot fail to give it serious consideration in the preparation of any science curriculum. When an industry takes rank with the nation's leaders, its economic influences are so varied and manifold, its social consequences so involved, that educational processes must take urgent cognizance of the need for study. Too, when reckoning is given those manufacturing operations which are sustained in great part by the paint industry, e.g., oils, bone black, carbon black, lamp black, glue and adhesives, resins, plastics, *etc.*, this valuable industry assumes an added importance. This highly integrated industry is disclosed in its true perspective as the core of an economic structure that provides a truly substantial part of commodity production in the United States. The trend of statistics from 1927–1937 offers sharp definition to the position of the industry in its relation to others in the chemical and allied fields and establishes the contribution made to industrial growth by the paint, varnish and lacquer industry.

By comparing the various chemical and allied industries from 1929 to 1937, as to number of establishments, wage earners, total wages, average wages, salaried employees, total salaries, salary per person, cost of materials, value of products, value added by manufacture and exports and

imports, we find indication of the strength of this industry, reflecting the direction of its progress and the extent of its gain.

The Third Factor Considered: The Demand for Skilled Men in the Industry.—Here it must be remembered that the demand for skilled men specializing in the paint, varnish, and lacquer industry is not limited to this industry alone but is also required by related industries as bone black, carbon black, lamp black, plastics, resins, animal and vegetable oil industries as well as manufacturers of chemicals. It is reasonable to assume from the above as well as from a consideration of statistics that the number of men connected directly or indirectly with this industry exceeds by far all others.

The Fourth Factor Considered: The Cost of Re-equipping or Furnishing a Laboratory for the Course.—Examination of the equipment costs reveals that if an attempt were made to introduce any of the chemical industries, save the soap or paint industries, into a science curriculum, a minimum expenditure running well into thousands of dollars would be required for the installation of a complete, commercial manufacturing unit on a miniature scale, regardless of the number of students. For the installation of just one miniature unit for paint manufacture together with other apparatus and equipment, less than $1000 would serve. However to avoid delay in instruction and to facilitate thorough teaching of the course, it is proposed to install a few complete units; a proposition that is feasible for instruction in paint and soap manufacturing methods but not in the other instances.

The Fifth Factor Considered: Difficulty in Teaching the Subject.—The discussion of the previous topic reveals that individual instruction would not be practical for the important chemical industries, apart from the paint and soap industries, if the cost of financing such instruction were too great. The only solution to the latter problem, therefore, would be the presentation of those courses in project form, the limitations of which, when compared with individual instruction, are well known. The final achievements, then, would be of doubtful value. However, if there were fairly definite assurance that the student would acquire a working knowledge of the industry from a combination of theoretical chemistry with information received from industrial study, regardless of the method of instruction, the end would justify the expensive means. As to whether or not an institution would be willing to consider so great an investment is entirely another problem.

From a comparison of tentative methods of instruction, the individual method for the paint and soap industries and the project method for the others, assurance of success can be predicted for the former while for the latter the outcome is questionable. Individual instruction and laboratory work allow for a greater degree of freedom in idea expression, and is of immeasurable value in acclimating the student to the routine of a commercial plant and laboratory.

CONCLUSION

This study has attempted to organize the pertinent data related to the paint, varnish and lacquer industries into a form from which definite conclusions can be drawn, stating the significant position of the aforementioned industries in the American industrial picture. In order to underline clearly this object statistics have been analysed, (although not quoted due to limitations of space) and references made to factual sources.

It has been shown through inspection of statistics on industrial behavior through the recent census period and on export and import totals that the paint, varnish and lacquer industries have established permanent roots in the economic organism, that

they comprise a large and important industrial group, employing great numbers of men and contributing vast sums in salaries and wages which bolster consumer purchasing and promote general prosperity.

Five factors have been stressed to give a comprehensive insight into the method used to justify the adoption of a practical science course in paint, varnish and lacquer chemistry. The first factor considered, established the healthiness of the industries through the use of "the state of development, the stability and future possibilities of a particular industry" criterion. The importance of the industry to society was conceded by convincing figures on wages, employees, etc., driving forward its indispensability and the huge responsibility that resides in its operation. The demand for skilled labor, as discussed in the third factor, brought home the better possibilities for trained men in these industries. Fourthly, preference logically led to courses of instruction in these subjects by reason of the comparatively minor expense involved in laboratory equipment used and the more easily explored subject matter.

The text bears toward one single conclusion—the prime justification for the introduction of a practical course in paint, varnish and lacquer chemistry in colleges and universities. In support of this contention are the current demand for trained men and highly attractive remunerative possibilities plus the utilitarian manner of instruction, combining theoretical training with practical application. The author recognizes, however, that in the path of the adoption of this course, the most formidable factor is the refusal of the educational system to take inventory of itself and the economic and social systems.

Future possibilities are large and diverse; logical and practical foresight should encourage the student to consider this vocation. The field is wide and room exists for men who train specifically in this industry.

THE EFFECTIVENESS OF CHARTS IN THE TEACHING OF CERTAIN UNITS OF COLLEGE BIOLOGY *

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Visual instruction is the use of concrete materials such as charts, models, drawings, motion pictures, lantern slides, specimens, microprojector, stereoscope, etc., in order to clarify and give meaning to teaching. Visual aids have been and will always be important educational tools. In order to obtain as much benefit as possible from them, they must be judiciously and correctly applied in a given situation. These tools must be handled in the proper manner in order to help students solve their problems and stimulate their interest in acquiring new knowledge.

The use of charts in teaching biology has been little investigated. Huebner [1] compared the effectiveness of models, charts and teacher's drawings in the teaching of plant structures. She found that models and teacher's drawings were superior to charts, and that the difference in educa-

* Based on a thesis submitted for the degree of Master of Science in Education in the School of Education, the College of the City of New York, January, 1940.

[1] Dorothy E. Huebner, "A Comparative Study of the Effectiveness of Models, Charts and Teacher's Drawings in the Teaching of Plant Structures," *School Science and Mathematics*, Vol. XXIX, January, 1929, pages 65–70.

tional value between models and teacher's drawings depended on the ability of the teacher to make good diagrammatic drawings. It may also be added that, to the extent that charts are well made and capable of being interpreted by the students, they will be functional in elucidating structures in biology.

An old Chinese proverb with much wisdom inherent in it states: "A single clear picture is worth ten thousand words of description." It follows that a single clear chart judiciously used in the biology laboratory, may be quite effective in clarifying laboratory work.

PROBLEM

The aim of this study was to determine how effective charts are in teaching biology, but since it is possible that charts may be very useful with one topic and less useful with another, the problem was therefore limited to a determination of the effectiveness of charts in the teaching of certain units of college biology.

In the present study, "effectiveness" means capability of aiding the acquisition of knowledge in the biology laboratory. "Chart" refers to an accurate representation of the essential features of the material under investigation or the animals being studied. "Unit" refers to the topic taken up in the laboratory. "College biology" is taken to denote the general biology course given in most colleges.

Eight sections of Biology 2 students at The City College were used in the main experiment which was carried out during the spring term of 1939; four additional sections were used in the check experiment in the summer session of 1939.

Each section has approximately 20 students. Those taking Biology 2, which is the second semester of the one year general biology course, study the earthworm, lobster, grasshopper, frog and pig respectively. Each section meets once a week for four hours: three hours of laboratory work and one hour of recitation. In order that adequate conclusions be drawn from any study, a large number of students should be used, and the experiment repeated a number of times. The total number of students used in this study was 186:—140 in the main experiment and 46 in the check experiment. Therefore any conclusions drawn from the results must, of necessity, be made on the basis of this number of subjects.

When students fill out their programs at the time of registration, they naturally choose the biology section which fits their programs best. Therefore, a section is filled by chance, and the assumption is made that the students in this experiment represent a random sample. It is also to be taken for granted that the students who participated in this study have never thoroughly studied the work involved in the four units chosen; an exception would have to be made where a student repeated the subject due to previous failure. Finally one must assume that the students previously never saw or took the tests used in the experiment. This latter assumption is clear, since the tests did not exist before this study was made. The effectiveness of laboratory work depends on a number of factors such as student preparation, laboratory facilities, kind of instruction, *etc.*, and an attempt was made to keep these as constant as possible.

METHOD

Two classes of about twenty students each meet at the same time in the general biology laboratory, which accommodates forty students. Each class has a separate instructor who conducts his recitation in a separate room. For convenience, the two classes meeting together in the laboratory are jointly designated by a single letter. Henceforth in this experiment, the word "section" will refer to the double class.

The four sections in the main experiment and the two sections in the check

experiment were chosen at random. Since the procedure of the check experiment, which was conducted to find out if the same results would be obtained, was the same as that in the main experiment, only the necessary information concerning the latter will be given. The sections were divided into two divisions, each division having two sections. Table I lists the information concerning each section.

It was thought best to choose sections which met at the same hours, as is evident in Table I. Except for the variable factor, charts, the students were permitted to use their general biology text, *General Biology* by James W. Mavor, their Biology 2 laboratory manuals, available models, and the same types of specimens. It must also be remembered that the instructors were different for each section, a variable which must be considered when judging the results.

The units and charts involved in the experiment are described. For Unit 1—External Anatomy of the Lobster—two charts were used. One chart showed the external anatomy, including the exoskeleton covering the entire animal and the appendages. The dorsal portion of the exoskeleton was cut away, so that the major arteries and most of the internal organs could be seen. The chart was in color, and was chosen because it was the best available for the unit. The other chart showed a cross section of the lobster, designating external and internal relationships. It had been made by a member of the biology staff.

For Unit 2—Internal Anatomy of the Lobster—the charts were those which had been used for Unit 1, with the emphasis placed on the internal anatomy of the lobster.

For Unit 3—External and Internal Anatomy of the Grasshopper—two charts were used. The first, which was in color, was a clear representation of the internal organs of the grasshopper, in relation to the external features. The second chart, also in color, illustrated the mouth parts and metamorphosis of the insect.

In Unit 4—The Internal Anatomy of the Frog—the chart used was in color, and showed a ventral dissection of the frog with the internal organs laid out.

TABLE I

General Information Concerning Sections

Division	Section	Day	Laboratory	Recitation
I	S W	Monday Wednesday	3–6 P.M. 3–6 P.M.	2–3 P.M. 2–3 P.M.
II	F H	Monday Wednesday	12–3 P.M. 12–3 P.M.	3–4 P.M. 3–4 P.M.

In all cases, those charts were chosen with the instructors and the writer thought best represented the material studied. Also, the figures on the charts are not ordinarily found in texts of general college biology.

Table II summarizes the method in which the study was carried out.

Each unit corresponds to a week, since a new unit is taken up each week. At the beginning of the laboratory period, in those sections which used charts, the latter were hung up in the laboratory in full view of all the students. One of the instructors in each section gave an introductory talk relevant to the work to be studied during the ensuing three hours, briefly referring to the chart or charts. After this short

TABLE II

ESSENTIAL PLAN OF THE EXPERIMENT

Division	Section	Unit 1 Week 1	Unit 2 Week 2	Unit 3 Week 3	Unit 4 Week 4
I	S W	Charts No Charts	No charts Charts		
II	F H			Charts No Charts	No Charts Charts

introduction, the students went to work and those sections using charts were allowed to refer to them as much as possible. Sections not using charts were also given an introductory talk. The same manuals, texts and specimens were used by all the students.

In carrying out the experiment, the rotation pattern was used, not only to find out if charts were effective, but also to discover whether one section of a division was composed of more superior or inferior students than the other. For instance, if section S were to receive an average higher score than section W, both when using charts and when not using charts, then it is evident that we are dealing with a group composed of superior students. Table II shows that section S used charts week 1, while section W did not. The second week the procedure was reversed, section W using charts this time and section S having no charts. The same procedure was followed for sections F and H the third and fourth weeks.

Table III demonstrates the plan of tests.

The first tests (tests a, b, c, d, in Table III) were each composed of twenty short answer questions chosen by the instructors, and covered the work taken up in the laboratory. The retention tests (Tests a(R), b(R), c(R), d(R) in Table III)

TABLE III

PLAN OF FIRST TESTS AND RETENTION TESTS OF SECTIONS WHICH USED CHARTS AND THOSE WHICH DID NOT USE CHARTS

Section	Unit 1 Week 1	Unit 2 Week 2	Unit 3 Week 3	Unit 4 Week 4	Week 5
S	Charts Test a	No Charts Test a(R) Test b	Test b(R)		
W	No Charts Test a	Charts Test a(R) Test b	Test b(R)		
F			Charts Test c	No Charts Test c(R) Test d	Test d(R)
H			No Charts Test c	Charts Test c(R) Test d	Test d(R)

TABLE IV

MEANS AND STANDARD DEVIATIONS FOR THE FIRST TESTS ON ALL FOUR UNITS, MAIN EXPERIMENT

Unit	Means		Standard Deviations	
	Charts	No Charts	Charts	No Charts
1	S 14.1	W 14.0	S 2.66	W 2.54
2	W 15.3	S 13.8	W 2.31	S 3.07
3	F 16.2	H 15.4	F 2.24	H 2.74
4	H 14.0	F 12.7	H 3.40	F 2.33

were constructed in the same manner as the first tests. The questions covered the same work, and were similar to those used on the first tests.

For each student the retention test score was tabulated next to the score of the first test. The difference between the two scores was calculated. Any student who was absent from either the first test or retention test was eliminated from the experiment. The total plus score was subtracted from the total minus score in each section, and the difference tabulated. A frequency table was made for each section, both for charts and non-charts, and the means and standard deviations were computed. In order to determine whether the obtained difference between charts and no charts was significant, the critical ratios were calculated using the formula:[2]

$$\text{Critical Ratio} = \frac{\textit{Difference between the Means } (M_1 - M_2)}{SE_{diff.}}$$

The reliability of each test was determined by use of the "split-half" technique of odd scores versus even scores. The coefficients of correlation were calculated by the product moment method using an assumed mean. For details of this method, consult any good book dealing with educational statistics.[3]

In the determination of the correlations between scores on the first tests and retention tests, the Spearman-Brown formula was not applied, because the split-half technique was not used in these computations.

TABLE V

MEANS AND STANDARD DEVIATIONS FOR THE FIRST TESTS ON THE TWO UNITS OF THE CHECK EXPERIMENT

Unit	Means		Standard Deviations	
	Charts	No Charts	Charts	No Charts
1	C 14.6	A 14.3	C 3.45	A 3.46
3	A 18.2	C 16.7	A 1.81	C 2.18

RESULTS

Table IV shows the means and standard deviations for those sections which used charts, and those which did not use charts, for the first tests on all four units of the main experiment.

[2] Garrett, Henry E. *Statistics in Psychology and Education*. Longmans, Green and Co., New York; 1938, pages 212–213.

[3] Garrett, Henry E. *Statistics in Psychology and Education*, Longmans, Green & Co., New York; 1938, pages 265–270.

TABLE VI

ONE WEEK RETENTION FOR THE FIRST TEST OF SECTIONS IN THE MAIN AND CHECK EXPERIMENTS

Unit	Main Experiment		Check Experiment	
	Charts	No Charts	Charts	No Charts
1	S −58	W −100	C +17	A +23
2	W +1	S −3		
3	F −23	H +3	A −13	C −21
4	H +134	F +88		
	+54	−12	+4	+2

From the means, it can be seen that in every case where charts were used, the mean for that section is greater than the mean of the section which studied the same unit and did not use charts. The letters S, W, F, H, refer to the sections which participated in the main experiment, and A and C designate the sections which studied units 1 and 3 in the check experiment. In no case did a section which had no charts make a higher mean than one which had.

From Table VI, it can be seen that there is greater retention in sections which used charts. In cases where there was a gain of many points after one week as in unit 4, sections F and H, this seeming discrepancy may be attributed to the fact that the students studied a little more than usual, because their instructors told them that they would be given a very difficult examination. When the retentions for charts and no charts are added algebraically, the sums are mostly plus, and not minus as would be expected. Probably the students consulted sources during the one week interval, that would have given them more information than their own texts and manuals. However, the gain is in favor of sections using charts.

On the retention tests, as on the first tests, the means for those sections using charts are higher than those which did not make use of charts, as is evident in Tables VII and VIII.

Taking both the main and check experiments into consideration, one finds that on the first tests the difference between the means of sections with and without charts, varies from 0.1 to 1.5 points (.5 to 7.5 per cent). The retention test differences range from 0.1 to 2.9 points (.5 to 14.5 per cent).

TABLE VII

MEANS AND STANDARD DEVIATIONS FOR RETENTION TESTS ON ALL FOUR UNITS, MAIN EXPERIMENT

Unit	Means		Standard Deviations	
	Charts	No Charts	Charts	No Charts
1	S 12.4	W 11.4	S 3.14	W 3.62
2	W 15.4	S 14.4	W 2.81	S 3.64
3	F 15.6	H 15.5	F 2.56	H 2.24
4	H 18.0	F 15.1	H 1.87	F 2.46

TABLE VIII

MEANS AND STANDARD DEVIATIONS FOR RETENTION TESTS ON THE TWO UNITS OF THE CHECK EXPERIMENT

Unit	Means		Standard Deviations	
	Charts	No Charts	Charts	No Charts
1	C 15.4	A 15.3	C 2.63	A 2.43
3	A 17.6	C 15.8	A 1.88	C 2.15

This may not at first seem to be great, but when we consider that the students were permitted to use all other facilities besides charts, such as texts, manuals, specimens and models, then one must realize that the difference between charts and no charts is inherently large due to this very fact.

In the main experiment, as seen in Table IX, the critical ratio for the first tests is 2.54. Consulting a special table [4] this is found to mean that the chances are 99.5 out of 100 that the obtained difference is significant—that the true difference is greater than zero. Table X shows the critical ratio for the retention tests to be 1.89, the chances here being 97 out of 100.

Tables XI and XII show the critical ratio results for the check experiment. The critical ratio for the first tests is 1.12, the chances being 86.5 chances in 100 that the difference is significant. Since the critical ratio for the retention tests is 1.41, the chances here are 92 in 100. The smaller critical ratios in the check experiment are probably due to the fact that only two units were used, and to the much smaller number of students, 46, in the check experiment, as compared with 140 in the main experiment.

The reliability coefficients of the first and retention tests of the main and check experiments are given in Tables XIII and XIV. The correlations between the first and retention tests are shown in Table XV. It is evident that the first and retention tests have quite high reliabilities. As is to be expected, the correlations between the first and retention tests are lower than the self-correlations. This may have been caused by a number of factors. For instance, students may have studied very hard and thus gained four or five points on the retention test. Also, students who have poor memories would have dropped down by a number of points. Some students may not have been feeling well, or may not have been interested in the work, or may have had other examinations to study for and consequently could not concentrate on the biology test. Thus such intangible factors may have contributed to diminishing the chances of equalizing the first and retention test scores.

[4] Garrett, Henry E. *Statistics in Psychology and Education.* New York: Longmans Green and Co., 1938, page 213.

TABLE IX

RESULTS IN THE PROCESS OF CALCULATING THE CRITICAL RATIO FOR THE FIRST TESTS

M_1	M_2	SD_I	SD_{II}	SE_{m_1}	SE_{m_2}	Diff. M_1-M_2	$SE_{diff.}$	$\frac{Diff.}{SE_{diff.}}$
14.92	13.27	5.48	5.37	.47	.45	1.65	.65	2.54

TABLE X

RESULTS IN THE PROCESS OF CALCULATING THE CRITICAL RATIO FOR THE RETENTION TESTS

M_1	M_2	SD_I	SD_{II}	SE_{m_1}	SE_{m_2}	Diff. M_1-M_2	$SE_{diff.}$	Diff. / $SE_{diff.}$
15.35	14.04	5.27	6.11	.45	.52	1.31	.69	1.89

TABLE XI

RESULTS IN THE PROCESS OF CALCULATING THE CRITICAL RATIO FOR THE FIRST TEST, CHECK EXPERIMENT

M_1	M_2	SD_I	SD_{II}	SE_{m_1}	SE_{m_2}	Diff. M_1-M_2	$SE_{diff.}$	Diff. / $SE_{diff.}$
16.40	15.47	3.89	4.09	.57	.61	.93	.83	1.12

SUMMARY

On the basis of the tabulated results presented above, the following conclusions may be drawn:

(1) When charts are used, supplemented by other visual aids such as models, specimens and texts in the general biology laboratory, they are effective to an extent revealed by the following data:

a. On the first tests in the main experiment, with 140 students, the average mean of all those sections using charts was 14.92 out of a possible 20. The average mean for sections not using charts was 13.27, a difference of 1.65 points (8.25 per cent) between the two means. The critical ratio was 2.54, which showed that the chances are 99.5 out of 100 that the obtained difference is significant.

b. On the retention tests in the main experiment, with 140 students, the average mean of sections which used charts was

TABLE XII

RESULTS IN THE PROCESS OF CALCULATING THE CRITICAL RATIO FOR THE RETENTION TESTS, CHECK EXPERIMENT

M_1	M_2	SD_I	SD_{II}	SE_{m_1}	SE_{m_2}	Diff. M_1-M_2	$SE_{diff.}$	Diff. / $SE_{diff.}$
16.50	15.54	3.23	3.24	.48	.48	.96	.68	1.41

TABLE XIII

RELIABILITY COEFFICIENTS OF FIRST TESTS WITH SPEARMAN-BROWN FORMULA APPLIED

Main Experiment				Check Experiment			
Charts	PE_r	No Charts	PE_r	Charts	PE_r	No Charts	PE_r
.54	.05	.59	.05	.85	.05	.88	.04

TABLE XIV

RELIABILITY COEFFICIENTS OF RETENTION TESTS WITH SPEARMAN-BROWN FORMULA APPLIED

Main Experiment				Check Experiment			
Charts	PE_r	No Charts	PE_r	Charts	PE_r	No Charts	PE_r
.79	.03	.75	.04	.88	.04	.84	.05

15.35, as compared with 14.04 for sections not using charts, a difference of 1.31 points (6.55 per cent). The critical ratio was 1.89, which showed that the chances are 97 out of 100 that the obtained difference is significant.

c. On the first tests of the check experiment, with 46 students, the average mean of all those sections using charts was 16.40 out of 20. That for sections without charts was 15.47, a difference of .93 points (4.65 per cent). The critical ratio was 1.12, the chances thus being 86.5 out of 100 that the obtained difference is significant.

d. On the retention tests of the check experiment, using 46 students, the average mean of sections with charts was 16.50, as compared with 15.54 for sections without charts, a difference of .96 points (4.80 per cent). The critical ratio was 1.41, the chances being 92 out of 100 that the obtained difference is significant.

e. Taking all the first tests of both the main and check experiments into consideration, the lowest obtained difference between a section which used charts and one which did not for the same unit, was 0.1 point; the highest difference was 1.50 between the means of the two sections (7.5 per cent).

f. Considering all the retention tests, the smallest difference between the means of a section which used charts and one which did not, having studied the same unit, was 0.1 point; the greatest difference was 2.90 points (14.5 per cent).

g. The means of all those sections which used charts on both first and retention tests varied from 12.4 (62 per cent) to 18.0 points (90 per cent).

h. The means of all those sections which did not use charts on the first and retention tests varied from 11.4 points (57 per cent) to 16.7 points (83.5 per cent).

(2) Charts are useful and aid in retention of facts in studying the following topics: (1) external anatomy of the lobster; (2) internal anatomy of the lobster; (3) external and internal anatomy of the grasshopper, and (4) internal anatomy of the frog.

TABLE XV

CORRELATIONS BETWEEN FIRST AND RETENTION TESTS

Main Experiment				Check Experiment			
Charts	PE_r	No Charts	PE_r	Charts	PE_r	No Charts	PE_r
.38	.05	.51	.04	.55	.07	.43	.08

Editorials and Educational News

STUDY OF TERMINAL EDUCATION IN JUNIOR COLLEGE

The American Association of Junior Colleges has received a grant of $25,000 from the General Education Board, of New York City, to finance a series of exploratory studies in the general field of terminal education in the junior college. Approximately 500 accredited junior colleges are now found in the United States besides another hundred which are not yet thus recognized.

About two-thirds of the 175,000 students enrolled in these institutions do not continue their formal education after leaving the junior college. The new study will be concerned particularly with courses and curricula of a semi-professional and cultural character designed to give this increasing body of young people greater economic competence and civic responsibility. There is increasing evidence that existing four-year colleges and universities are not organized adequately to meet the needs of a large part of this significant group.

It is anticipated that the exploratory study will reveal the need and the opportunity for a series of additional studies and experimental investigations and demonstrations which may cover several years of continuous effort.

The new study will include a large proportion of the junior colleges in the United States. It will be sponsored by a nationwide representative committee.

Immediate responsibility for the study will be vested in an executive committee consisting of Rosco C. Ingalls, Chairman, Doak S. Campbell, and Byron S. Hollingshead. The Director of the study will be Walter Crosby Eells, Executive Secretary of the American Association of Junior Colleges, Washington, D. C.

SUMMER CONFERENCE OF THE NEW ENGLAND ASSOCIATION OF CHEMISTRY TEACHERS

The first Summer Conference, held last August at the University of Vermont, was so successful that the Executive Committee of the New England Association of Chemistry Teachers has voted to hold a second conference this summer. The meetings will be held on the campus of the University of Maine on August 13, 14, 15, and 16, 1940. The morning and afternoon sessions will be devoted to topics of current interest pertaining to the teaching of chemistry in secondary schools and colleges and recent advances in scientific knowledge. Speakers of national reputation will participate. Meals and lodging will be provided at a very low rate by the University, and accommodations for families will be available. A social program, taking advantage of the location of the conference at one of the country's foremost vacation spots, is being planned.

The Committee in Charge is comprised of the following: Dr. Lawrence H. Amundsen, of the University of Connecticut; Prof. Avery Ashdown, of the Massachusetts Institute of Technology; Prof. Charles A. Brautlecht, of the University of Maine; Mr. Roscoe Dake, of Phillips Academy; Mr. Standish Deake, of Milton Academy; Mr. Everett F. Learnard, of Norwood Senior High School; Miss Eva Ruggli, of the Cambridge Latin School; and Mr. Theodore C. Sargent, of Swampscott High School, Chairman. The following officers of the association are also serving *ex-officio*: Mr. Ralph E. Keirstead, of Wethersfield High School, President; Prof. Laurence S. Foster, of Brown University, Vice-President; and Mr. W. Davis Chase, of the New Britain High School,

Advertising Manager of the report of the N.E.A.C.T.

There will be a registration fee of $2.00 for members in the association who register before August 1st, and $3.00 for those who register later than this date. Non-member teachers from New England, or elsewhere, who wish to attend, may do so by paying the usual membership fees of $3.00 for a full membership and $1.50 for an associate membership. Payment of registration fee is not required of members of the immediate family of teachers attending the conference.

For further information, a letter should be sent to Mr. Theodore C. Sargent, 834 Humphrey St., Swampscott, Mass.

NEW 16 MM. SOUND PROJECTOR

The RCA Manufacturing Company has announced a new 16 mm. sound motion picture projector. Known as Model PG-170, the projector was designed specifically for use among schools and by industrial users of 16 mm. films.

Developed by the same RCA Photophone engineers who have designed 35 mm. sound motion picture equipment now in use in production studios and theaters, this projector meets the exacting requirements of theatrical projection at moderate cost. The price is $300.

Simplified in construction to provide exceptional ease of operation, the new RCA projector has many features which are especially interesting to schools. These include:

Unusually brilliant projection with a standard 750-watt lamp; RCA Photophone sound with push-pull amplification—10-watt output; simplified threading with threading line on projector casting; theatrical framing—no change of projector position; efficient cooling of projection lamp. The lamp itself is quickly changed and the lamphouse remains cool after long operation.

The machine's sound reproduction is accomplished with RCA stabilized sound, with the sound drum mounted on shielded ballbearings; shockproof stabilizer between take-up reel and sound drum; rigidly mounted and easily accessible sound optical system; and an electro-dynamic speaker mounted in separate case. The output of life-like sound is sufficient for any classroom or the average school auditorium.

One of the interesting features of the new RCA projector is the separate motor for film take-up and rewind. This eliminates entirely the use of exterior belts and is instantly adjustable to provide proper tension for 400, 800, 1200 or 1600-foot reels.

Other features include one-point lubrication of high speed parts—all journals are permanently lubricated; sound and silent film projection speeds with governor-controlled motor; easy cleaning of aperture gates; provision for using microphone for public address or to explain either silent or sound films during projection; connection for record players using either crystal or magnetic pickup; variable tone control; and extreme portability of projector (39 lbs.) and speaker (20 lbs.), both cased in attractive and durable black fabrikoid.

THE AMERICAN INSTITUTE PUBLICATIONS

Science teachers in the field will be interested in the following announcement from this organization which, as a non-profit agency of public education in science, has been of great service in New York City.

The American Institute is not in the publication field on a competitive basis. It wishes to announce two of its publications: *The Science Leaflet* and *The Science Observer*. The subscription rate on the *Leaflet* is $2.00 per year; on the *Observer*, fifty cents a year. If both publications are subscribed for the following rates apply: the *Observer*, 35 cents, and the *Leaflet*, $1.80.

THE AUDUBON NATURE CAMP

A unique camp whose purpose is the promotion of conservation through special training of teachers, youth leaders and

others interested in stimulating more nature study, is conducted each summer on an island sanctuary in Muscongus Bay, Maine. This is the Audubon Nature Camp for Adult Leaders. It is operated at cost by the National Association of Audubon Societies. It will open for its fifth season June 14, 1940.

The camp site offers 330 acres of virgin spruce forest which, together with the open meadows and hardwood forests of the adjacent mainland, the fascinating shores, many nearby and outlying islands, afford an unusual variety of habitat. The setting is ideal in the interests of nature study. The two-week program consists of small informal out-of-door classes for observing living plants and animals in their natural environment. Expert guidance in the field leads campers to an understanding of the many interrelationships existing between all forms of life. Practical program suggestions for use in schools, camps and clubs are offered and every effort is made through individual conferences between campers and the staff to adapt these to each camper's needs.

Beginners and advanced nature students alike will gain valuable experience and inspiration from this camp.

Enrollments may be made for one or more of five two week periods offered during the summer of 1940. For an illustrated folder describing in detail the program and facilities of the camp, write to Camp Registration Department, National Association of Audubon Societies, 1006 Fifth Avenue, New York, N. Y.

JUNIOR AUDUBON CLUBS

This is an idea for Boys and Girls interested in watching birds this spring and in finding out how they live. Junior Audubon Clubs are sponsored by the National Association of Audubon Societies, an organization whose purpose is the protection of all forms of wildlife. A special endowment enables the Association to furnish its Junior Members with interesting material at far below cost. Ten or more children may band together to form a club in a school, Scout troop, camp or in the home neighborhood. Club dues are ten cents a member each year. Each Junior Member receives a bird button and six four-page bird leaflets with bird color plates and outline drawings to color. For other details and registration form, write to the Junior Secretary, National Association of Audubon Societies, 1006 Fifth Avenue, New York, N. Y.

Abstracts

EDUCATION

CALDWELL, OTIS W. "Some Problems of an Education Minority." *Science* 89: 591–595; June 30, 1939.

This is an address given at the graduation exercises of the Medical College of Virginia, June 6, 1939. The author emphasizes the imprint that science has made and is making upon modern civilization. Growths of certain aspects of scientific knowledge are pointed out. The author states that "One of the biggest, probably the biggest, problem for an educated minority is that of extending the way of working, which is characteristic of discoverers, the real desire to know and use proved knowledge. Man's inquiring and dynamic mind is a scientific fact of the greatest significance. Man is an adventurous animal, always attempting something no one has yet succeeded in doing. At his best, man always wants to do something for society which has not yet been accomplished. Surely, society has the right to expect the educated minority to be its sure-footed leaders, rather than that their superior education may be used by them merely to gain increased personal benefits through exploitation of their advantages."

—C.M.P.

BOWMAN, ISAIAH. "Science and Social Pioneering." *Science* 90: 309–319; October 6, 1939.

The first part of the article summarizes the results of a questionnaire study of leading non-scientists as to contributions of science to social welfare. Replies are summarized in three categories: (1) emphasizing the gains, (2) qualified approval, and (3) losses.

Science is effecting social changes and it is not to be wondered at that social forms cannot keep pace with advancing science. A time lag is inevitable because we have found no way to teach and test ideas except through time-consuming and often inconclusive experience.

—C.M.P.

BUTTERFIELD, ERNEST W. "Saltatory Education." *The Clearing House* 14: 202–204; December, 1939.

Whether seriously or humorously, the abstractor cannot decide, the author attempts to hold a premortem autopsy of Progressive Education. He says Progressive Education has two weaknesses: (1) at the beginning, it got off to a bad start. It appealed to the emotions and became a matter of religion to its promoters and followers; (2) the second weakness was the testy attitude of many of its professors. The author proposes a new educational movement beginning about 1945 called the Saltatory Education, a term meaning literally, "I keep on jumping." It would emphasize the present.

"Once again it is permitted to organize a school about a teacher. We may even use textbooks and declare confidence in them. We may, without shame, have a daily program and an orderly arrangement of sequential studies . . . leaders of educational movements never change. They go down with their ship."

The author describes a true child-centered school as: "The child is alone in his educational nudity on the center of the stage. He must not be forced, he must not be led, he must not be guided, he must be allowed to develop as nature has proposed. Around him, in an anxious circle, are a nurse, a psychologist, a nutrition expert, a play specialist, a teacher of expression, and a superintendent. At the first sign that the child wants something, all go into a huddle and determine the meaning of the sign. Then the appropriate stimulus is brought near."

—C.M.P.

RICE, STUART A. "Standards of Living as Functions of Science and of Social Organization." *Science* 90: 167–172; August 25, 1939.

This is an excellent discussion of the difficulties inherent in defining the phrase, "standards of living," who shall define the standard, to whom can such a standard be applied, and how to avoid changing norms for desirable minimum standards of living. The author also discusses the present hazard of a slow decay of present social organization or as H. G. Wells forecasts in his "Shape of Things to Come," a catastrophic breakdown in social organization as a result of another world war involving unparalleled destructive efficiency.

—C.M.P.

HAMBIDGE, GOVE. "Toward a New Design for Education." *Reprint from Harper's Magazine*, October, 1938.

The author discusses the values of college education based on his own experiences and observations and analyzes the Carnegie Foundation study of Pennsylvania Colleges, a study which has been reported in "The Student and His Knowledge."

The author raises the question as to whether traditional college methods and curricula can be changed. The author suggests a "personal curriculum" and briefly outlines how this might be achieved. —C.M.P.

CURTIS, OTIS F. "Education by Authority or for Authority? Are Science Teachers Teaching Science?" *Science* 90: 93–101; August 4, 1939.

This is condensed from the address of the retiring president of the American Society of

Plant Physiologists, at Richmond, Va., December 28, 1938. "The training of a person, if he is to be considered broadly educated, should be such as to give him understanding of himself, of the world about him and of his relationship to that world. It should give him a foundation for further advancement and an ability to further appreciate values and distinguish between the true and the false. It should prepare him to live with satisfaction in the present world; to meet without panic and without prejudice various problems as they arise; and he should be able not only to grow with, but also to help in improving, a growing world and changing civilization."

"Science is successfully taught only as its teachers can get their pupils to appreciate how advancement in knowledge is accomplished only gradually and by the critical examination and reexamination, the testing and retesting, of each step in a fabric of evidence. Training in science should make the individual more critical, should lead him out of superstition . . . should give training in evaluating evidence, in understanding and in solving problems for himself."

—C.M.P.

O'REAR, F. B. AND LINTON, CLARENCE. "Wanted: A College." *Teachers College Record* 41: 124–134; November, 1939.

The authors, first listing sources of present dissatisfaction, envision the most desirable type of college as to opportunities offered, services to be reasonably expected, and type of organizations.

—C.M.P.

SYMPOSIUM. "Education in Other Countries." *The Phi Delta Kappan* 22:73–146; November, 1939.

This is a series of articles by various individuals presenting the status of education in various countries: Turkey, Roumania, Bulgaria, Hungary, Finland, Italy, Switzerland, Germany, England, Wales, Canada, Cuba, South America, and the Western Hemisphere.

—C.M.P.

SPENCE, RALPH B. "Preliminary Steps in the Selection of a Research Problem." *The Advanced School Digest* 5:9–11; October-November, 1939.

The article discusses questions that research students should determine or ask themselves preliminary to starting a research problem. Among these problems are: the selection of an area, the type of research, the problem of time and place, and the sponsor.

—C.M.P.

BURT, CYRIL. "Formal Training." *The School Science Review* 20:653–666; October, 1939.

The author, a professor of psychology in the University of London, examines the pro's and con's of the doctrine of formal training. In summary, Doctor Burt says, "If we are teaching science, is it better to give each child a little research problem to carry out by himself in the laboratory, or to make him learn a systematic body of facts and generalizations from a textbook with suitable demonstrations and exercises to clothe the abstract statements with a concrete meaning? . . . I am willing to agree that the former method may be the quickest and surest in yielding visible results, but I believe it has marked limitations. I am convinced that the latter method has both its value and its dangers—in theory and in practice it has been so unjustly neglected."

—C.M.P.

CLARK, HAROLD F. "The Learning of Subject-Matter." *Teachers College Record* 41: 102–115; November, 1939.

The author attempts to show how the student can learn what is necessary of the old subjects and also get the material essential to living. Shortcomings of the subjects now taught and how they might be made to function more effectively is discussed.

In regards to science the author states that science teaching has fallen short because it was first seemingly assumed that all students were going to become scientists. Next it was claimed that the purpose of science instruction was to give general training in the scientific method. The author believes the way out lies in relating science to the important areas of human life.

—C.M.P.

EBY, KERMIT. "Intellectual Honesty—An Asset to Good Teaching." *The Clearing House* 14: 148–151; November, 1939.

Teachers as human beings cannot be purely objective nor are they fountain sources of all knowledge. They carry into the classroom all sorts of bias, prejudices and ignorances. To be perfectly fair they should warn the pupils they are prejudiced in favor of one viewpoint and attempt to impartially present the other side. They should admit they *do not know,* when the circumstance arises.

—C.M.P.

POTTHOFF, EDWARD F. "Simplifying the Combinations of Subjects Assigned to High School Teachers." *University of Illinois Bulletin* 36: 1–66; June 27, 1939.

This is the resumé of an exhaustive study carried out in the state of Illinois. Phases of the report are: (1) introduction and summary, (2) present status of the problem, (3) construction of a simplified system of teaching combinations, (4) evaluation of the simplified system of combinations, and (5) conclusion: effecting the simplification of combinations in actual progress.

Recommendations in science include: (1) science teachers should have two teaching fields; (2) teachers preparing for a combination which includes biological science should have a minimum of 30 hours in this field for a major and 20 hours for minor; (3) preparation for either a

major or minor in general science should include both the biological and physical sciences with a minimum of 25 hours from chemistry, physics, astronomy and geology, and 15 hours of biological science; (4) chemistry and physics a minimum of 16 hours each.

Mathematics is a good field to combine with physics or chemistry. Science is also often associated along with teaching majors or minors in Home Economics.

—C.M.P.

ANONYMOUS. "The Teacher Looks at Teacher Load." *Research Bulletin of the National Education Association*, November, 1939.

This report on teacher load is divided into the following divisions: (1) introduction, (2) the teaching situations represented in this study, (3) the reasonableness of teaching loads as related to various teaching situations, (4) evaluation of specific factors in present teaching loads, (5) the consequences of unduly heavy teaching loads, (6) teaching suggestions and recommendations with respect to various aspects of teaching load, and (7) summary and conclusions.

In the study 44 specific load factors were considered, but no single one was found to be consistently troublesome. About 44 per cent rated their teaching loads as unduly heavy. A reasonable class size is about 30 pupils with a maximum of 35. Science teachers do not seem to have any heavier teaching loads than other individuals.

—C.M.P.

FREMBLING, L. ROBERT. "Seven Questions on Consumer Education." *The Clearing House* 14:228–230; December, 1939.

This article describes the experiences and set-up of the course in Consumer Education in the Union High School at Lodi, California. The course has been offered for three years and results have been most satisfactory.

—C.M.P.

BOSTICK, PRUDENCE. "They Did Not Go to College." *Educational Research Bulletin* 18: 147–162; September 13, 1939.

This is the resumé of a study of pupils of the Manual Training High School, Denver, who participated in the Eight-year Study and who did not go on to college. Thirty-one cases are included. The study shows the need for more careful attack on the whole problem of vocational training and counseling. A vocation is a serious problem for those young people who go directly from school into job-hunting.

—C.M.P.

DRISCOLL, GERTRUDE P. "The Behavior Summary as a Form of Pupil Report." *Teachers College Record* 41: 116–123; November, 1939.

Teachers and parents are expressing the desire for a more adequate form of report, one that will help them to interpret the behavior of children more accurately. The author suggests the following: (1) general description of the child, (2) relationship with his classmates, (3) relationship with teachers, (4) interests, (5) responses to interference or thwarting, and (6) attitudes toward skills and accomplishment.

—C.M.P.

SYMPOSIUM. "Techniques of Gathering Data on Characteristics of High School Students." *University High School Journal* 17: 181–233; June, 1939.

This article presents the techniques used in an investigation sponsored by the General Education Board.

—C.M.P.

REEDER, C. W. AND NEWMAN, S. C. "The Relation of Employment to Scholarship." *Educational Research Bulletin* 18: 203–214; November 15, 1939.

On a matched and paired basis, the purpose of this study was to determine what effect employment had on the academic record of the Freshmen entering the College of Commerce and Administration of the Ohio State University in the Autumn quarter, 1937. Workers were paired with non-workers, and the academic records were studied to see what differences in scholarship resulted. Women, Saturday-only workers and N. Y. A. appointees were excluded. Matching was on a basis of high school records, intelligence-test scores, sex, and nationality. Records of 246 students were used.

The study showed there is little relationship between the hours that students work and their scholarship.

—C.M.P.

STIRLING, MATHEW W. "Discovering the New World's Oldest Dated Work of Man." *The National Geographic Magazine* 76: 183–218; August, 1939.

This is an account of the Geographic-Smithsonian expedition to Tres Zapotes in the state of Vera Cruz. Here the expedition excavated the site of an early Mayan habitation. Among the finds is a Maya monument bearing the earliest date yet discovered in the Western Hemisphere. The date corresponds to November 4, 291 B.C. There are 41 illustrations.

—C.M.P.

AGHA, M. F. "Some Terrible Painters." *U. S. Camera* 1: 23, 69; October, 1939.

This article is not interesting because Mr. Agha presents evidence to show that frustrated painters developed photography. It is primarily interesting because the author presents evidence that James M. Wattles, of the Owen Community of New Harmony, Indiana, really invented photography in 1828. Wattles, seemingly, actually preceded Daguerre, Niepce, and others in first developing the process of photography. Honor thus comes late to another important American inventor. —C.M.P.

New Publications

Verrill, A. Hyatt. *Strange Animals and Their Stories.* Boston: L. C. Page and Company, 1939. 235 p. $2.50.

Few, if any, authors are as capable as Mr. Verrill in writing accurately and authoritatively about animals. The reviewer considers Mr. Verrill as one of the most outstanding American writers of popular science. Each of his several books are excellent books for junior and senior high school boys and girls, and are highly recommended for a place on the science book shelf. The author's vivid style, interspersed with interesting comments, makes for enjoyable reading.

In this book, *Strange Animals and Their Stories,* the author gives unusual information about such everyday animals as dogs, cats, horses, pigs and sheep, and also about such animals as wombats, sloths, aardvarks, okapis, and so on. In the tales that Mr. Verrill relates, one is struck by the strong personalities possessed by certain individuals. Animals, like human beings, have their individual pecularities and idiosyncracies. No generalized statement can be made that will describe the behavior of all animals of a given species. There are usually certain individual members whose behavior differs from that of the average.

—C.M.P.

Verrill, A. Hyatt. *Minerals, Metals and Gems.* Boston: L. C. Page and Company, 1939. 293 p. $3.00.

Here is an enjoyable book to read, written in popular and simple style, free from scientific and technical terms. The author relates much of the lore and facts commonly associated with precious minerals and gems. Practically without exception, each mineral, metal, and stone has some very interesting history connected with it. Many have strange and curious characteristics, and others fascinating discoveries and uses.

The author is well-qualified to write upon this subject because he is thoroughly familiar with it from study as well as from years of field work in geology and mineralogy.

This book is recommended for inclusion in the high school science book shelf on account of its authoritativeness, practicality and enjoyableness.

—C.M.P.

Maloney, T. J. (Editor). *U. S. Camera, 1940.* New York: Random House, Inc., 1939. 276 p. $2.95.

The one hundredth year of photography is superbly celebrated in this volume, the finest collection of pictures probably ever assembled in a photographic yearbook. There is a brilliant collection of color and black and white photographs of America's outstanding photographers.

There is an excellent article by Elizabeth McCausland on the history of photography during its first hundred years. The more than 300 photographs are grouped into the following sections: (1) Edward Weston's "Of the West," (2) children, (3) animals, (4) patterns, (5) negroes, (6) aviation, (7) news section, (8) photographs by Edward Steichen, and (9) panorama of America.

There is a brief description of each picture, usually stating the conditions under which the photograph was taken—camera, lens, aperture, film, paper, and so on.

This is an interesting book for anyone, as well as for all photographers, amateur as well as professional.

—C.M.P.

Symposium. U. S. Camera Magazine, December, 1939. 80 p. $0.50.

In addition to numerous excellent photographs in color, and black and white, there are several excellent articles on photography. Among these are: "The Lady, the Lens and the Law," by Alexander Lindey, "U. S. Camera Awards" (collection of photograph award winners with brief description of photograph), "American Aces," by Toni Frissell, "Aerial Photography," by Bradford Washburn, and "Photography of Architecture," by Ansel Adams.

There are a series of outstanding photographs on Abraham Lincoln: "The War Years."

—C.M.P.

Hammond, Arthur. *Pictorial Composition in Photography.* Boston: American Photographic Publishing Company, 1939. 155 p. $3.50.

Few photographers have a better knowledge of the needs of the amateur photographer than does the author. Forty years of practical experience including the writing of numerous articles and books, addressing countless camera clubs and judging photographic prints, is the background of experience upon which this book is based. In the author's words—in photography there is always something new to learn or a better way of doing present procedures. There are but few photographers who would not profit from reading and putting into practice the principles set forth.

Simple, practical rules of pictorial composition are given as applied to portraiture, landscape work, sunrise and sunset work, still-life studies, and so on. Among the many other phases discussed are spacing, massing, lines, balance, accent, suppression, use of filters, film speed and fine grain, exposure, print quality, negative developers, bromide enlarging, toning, bromoil, and finishing the print. There are 48 photographs illustrating the author's textual material.

—C.M.P.

LEE, EDWIN A. (Editor). *Teaching as a Man's Job.* Homewood, Illinois: Phi Delta Kappan, 1939. 79 p. $0.15.

This small pocket-sized pamphlet has been published by Phi Delta Kappa as professional propaganda to attract young men of good ability to the teaching profession.

Its factual material is well-presented. It outlines the various kinds of professional work usually included under the term teaching. This consists of classroom teaching at all school levels and the various phases of school administration. Statistics on salaries are frankly presented. The questions of hours and extracurricular work are adequately presented.

The booklet presents a well-done, brief summary of facts about teaching opportunities. It lacks a colorful presentation of the profession that might attract intelligent and ambitious young men. In this sense, it falls short of the objective stated in the preface.

The bibliography at the end is recommended to those interested in guidance as related to the teaching profession.

—R.K.W.

MACHINERY AND ALLIED PRODUCTS INSTITUTE. *Machinery and the American Standard of Living.* Chicago: Machinery and Allied Products Institute, 1939. 87 p.

This is an exceedingly interesting and well-written pamphlet on the history of the influence of machines on civilization. Included are interpretations of the effects of technological advancement upon the American standard of living. The illustrations and graphic presentations of statistical facts add to the attractiveness of the text.

Science teachers should be interested especially in such material as expressing some of the ultimate effects of scientific knowledge upon humanity.

The use of such material should be accompanied by an awareness that the sponsors have a direct personal and financial interest in the interpretations of the facts presented.

—R.K.W.

MACHINERY AND ALLIED PRODUCTS INSTITUTE. *Capital Goods and the American Enterprise System.* Chicago: Machinery and Allied Products Institute, 1939. 87 p.

This material has been produced for an association of manufacturers of heavy goods, defined in the book itself as capital goods. It is propaganda in defense of private capital and the profit motive in industry.

Certain major theses presented include the following:

"Saving and investment in hope of profit are therefore essential to the operation of the American system of private enterprise and to the perpetuation of the American tradition of individualism."

"Technology normally makes many old occupations obsolete, but it also normally creates many new ones, and the net result is an increase in employment opportunities—which is evident when we examine statistics on employment for America as a whole."

"This striking shift to tax exempt securities and away from investments in business is obviously still in process, and so long as the present tax rates continue business will be deprived of this capital which should be flowing into employment-making and wealth-producing enterprise."

Teachers of science who are interested in the social and economic consequences of scientific and technical advancement will want to read this volume. Undoubtedly it needs to be read along with other presentations of the same problems from varying points of view.

—R.K.W.

RHINE, J. B. *New Frontiers of the Mind.* New York: Farrar and Rinehart, 1937. 275 p. $2.50.

This book is a report of the series of studies carried on at Duke University on extra-sensory-perceptions. By extra-sensory-perception is meant mental awareness or consciousness produced by some other means than by sensory perceptions carried into the nervous system by means of the sense organs or sensory nerves. The man in the street uses such terms as mind reading, mental telepathy, or clairvoyance for such phenomena.

Most of the experiments were carried on with simple sets of cards carrying easily recognized symbols. There were five of these symbols and five of each in a set, making twenty-five in all.

Each subject attempted to name each card in order without being able to see or examine the card. Some experiments were conducted with the subject and the experimenter in different rooms.

Subjects averaged from five up to eight or nine correct responses out of a set of twenty-five, with some occasional instances of remarkably higher scores.

By statistical interpretations, the experimenter shows that these responses, especially for selected subjects, were considerably higher than might occur by mere chance.

The reasoning applied makes an assumption which, to the reviewer, is questionable. The fact that the correct responses of the subjects used in the experiments are greater than those secured by comparing the coincidences in two decks of shuffled cards does not necessarily show that extra-sensory-perceptions are the cause of the differences.

Most people trained in the natural sciences or in psychology will be skeptical of the results of these experiments. On the other hand, such investigations may in the long run throw some light upon certain obscure forms of human behavior. People often have been exceedingly skeptical of the early attempts in many kinds of scientific investigation.

—R.K.W.

STILES, PERCY GOLDTHWAIT. *Human Physiology.* Philadelphia: W. B. Saunders Company, 1939. 450 p. $2.25.

The eighth edition of this well-known text for high school and college students was made possible by the work of Dr. Gordon C. Ring, Assistant Professor of Physiology in the Ohio State University, who has been associated closely with Dr. Stiles over a long period of time. Dr. Ring has made minor changes where they were needed and has brought the materials up to date. He has retained the same clear, simple, stimulating style that has characterized the earlier editions.
—F.G.B.

MARSHALL, CLYDE. *An Introduction to Human Anatomy.* Philadelphia: W. B. Saunders Company, 1939. 388 p. $2.50.

This is the second edition of an elementary textbook in anatomy for beginning college students. It is simply and clearly written, brings up to date new knowledge relating to anatomy, emphasizes the functional activities of various organs of the body, and considers problems of practical value in a way that should stimulate students to think of anatomy in relation to living. Many of the illustrations in the first edition have been clarified and a number of new ones added. The book is exceptionally well-illustrated by 257 diagrams and drawings in black and white and 14 illustrations in color.

In 13 chapters, the author considers bones and joints; muscles, fasciae and skin; cells and tissues; the digestive, respiratory, urinary, reproductive, circulatory, and nervous systems; sense organs; ductless glands; and developmental anatomy.
—F.G.B.

PERRY, CLARENCE ARTHUR. *Housing for the Machine Age.* New York: Russell Sage Foundation, 1939. 261 p. $2.50.

Mr. Perry, who was with the Russell Sage Foundation from 1909 until 1937, has collected in this volume a considerable amount of information related to his extended work in the field of planned community housing. It might be thought of as a summary of his creative work toward better communal living.

In the beginning, he sets forth the elements of the situations which make cooperative planning a necessity if persons who wish to establish homes in the desired environment are to be successful. A total or partial change in the contemplated environment which so often makes the total situation entirely different after a few years may only be prevented by planning which controls the future environment in sufficiently desirable detail. This entails a fairly large housing program involving considerable portions of territory and facilitated, among middle-class people, by economical building utilizing automobile mass-production methods of dwelling fabrication.

The neighborhood unit formula receives explanation and amplification as a basically desirable plan. It includes considerations of size, boundaries, open spaces, institution sites, local shops, and internal street systems. Problems of individual and community financing so as to conserve values and obviate possible ultimate waste and failure of plans are discussed. Examples of attempted developments are used to point out difficulties and recommended safe-guards. Single family units and apartment house units are separately treated. Detailed data on procedures of attack in carrying out plans are given in the last half of the book. The social significance of these kinds of projects is emphasized in the last chapter. Numerous photographs and diagrams help the reader to understand the plans advocated.
—A.W.H.

SEARS, PAUL B. *Who Are These Americans?* New York: The Macmillan Company, 1939. 116 p. $0.60.

This is one of a series planned and edited by a committee of the American Association for Adult Education and designated as the People's Library. Included are essays or talks on varied phases of the lives of those who dwell in America and call it home. These are of many races and from many nations and are engaged in a unique experiment in democratic life or, at least, of getting along with one another. Our forefathers came and conquered and took possession. Since colonial times, the blending of the races has been in progress. What is America; who are Americans; who are my fellows; what are the forces which play upon us to change our lives and our very natures; what is the American pattern; what is science and education doing to us; what form of society is destined for the future; what shall we do to live more harmoniously together? These are the questions which the author discusses in an informal, philosophical, and homely manner.
—A.W.H.

WILLIAMS, JESSE FEIRING. *A Textbook of Anatomy and Physiology.* Philadelphia: W. B. Saunders Company, 1939. 607 p. $2.75.

This excellent book includes the essentials of anatomy and physiology written to meet the needs of professional students in fields of education, such as those studying nursing, physical education, and hygiene. The author's approach through origin and development makes more meaningful concepts relating to structure and function of bones, muscles, nervous system, and viscera. To aid with vocabulary, an extensive glossary is given. Three hundred sixty-seven illustrations in black and white and in color form an important part of the book.

This is the sixth edition of a widely used text. Important changes in this revision include bringing the content up to date; reorganizing and clarifying materials in chapters 1, 2 and 3; and including at the close of each chapter a section on how to study the chapter, suggested practical exercises, and questions relating to the materials included in the chapter. —F.G.B.

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